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AIR FORCE SCIENTIFIC RESEARCH BIBLIOGRAPHY

1962

by

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LIBRARY OF CONGRESS

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PREFACE

Prolegomenous Catechism

Q: What is the purpose and requirement for this publication?
A: The primary purpose of the Library of Congress effort is to provide an independent audit and back-up for AFOSR's documentation control system, delivering indexed abstracts of all AFOSR-sponsored publications. The publication per se accounts for only 5 percent of the cost of the effort, yet multiplies the utility by a factor of 1,000.

Q: Is the $726,000 this project has cost to date a reasonable expenditure of AFOSR research funds?
A: Yes. USAF spends 0.7 percent of its R&D budget on information activities: the total cost of the Bibliography is 0.45 percent of the AFOSR contract/grant budget during the period covered.

Q: Can the requirement for this publication be satisfied more expeditiously by other means?
A: More expeditiously, yes. More accurately and completely, no.

Q: What does this publication accomplish that is not already provided by a combination of other abstracting, indexing and announcement services?
A: Nothing that the skilled user or librarian couldn't do for himself, given sufficient time.

Q: What is the value of a 6-year old organizationally oriented publication to the scientific community?
A: One operational test of value is the market place. The Superintendent of Documents has sold almost 3,000 copies of this publication for a total price of $18,628.

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A: It was for Vol. I, covering the period from 1950-1956 when AFOSR had the sole specific basic research mission in the Air Force, but is not strictly correct for later volumes.

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Scope

This is the sixth 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 1962. Previous publications in this series have been:

Vol. I (1950-1956), issued in 1961
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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.

FOREWORD

It is again my pleasure to contribute a foreword to a volume of the Air Force Scientific Research Bibliography. The series is nearly a decade old, prompting me to look back to its origins and to review its purpose and accomplishments. From its inception by Harold Wooster, the Bib has been offered as a basic service both to the users of Air Force research, and to those who help make the product available to the users. The sheer bulk of the volumes in this series would seem to assure their use only by the dedicated. However, their comprehensiveness, organization and indexing also assure that the user will be aided in his efforts to identify specific research, or a paper, author, date, reference or contract number.

The decision to begin the series came from a sense of responsibility to make freely available, in the form of a comprehensive scientific and technical reference service, the written results of research resulting from AFOSR support. Just as we require our scientific investigators to publish their results, we feel an equal burden to show the results of our expenditure of public funds in our support of fundamental research related to Air Force operating needs.

Cataloguing for the first volume in the series was barely begun in time to assure reasonable completeness for the early years of AFOSR. The impetus, it is fair to say, came from the exponential rate of rise in those years of the total Federal research and development expenditures. The growth of Air Force research was somewhat less spectacular, but none-the-less interesting enough to justify the bibliographic effort. At that time the scientific and technical community found high on its list of worries the national threat of being overwhelmed with paper, something called the information explosion. Whether this threat ever quite developed is questioned by Wooster (1) Then, just as the nation had suddenly discovered science a few years before, science, it seemed, discovered documentalists. The only hope according to some analysts of the situation, was to create a vast central information system to put scientists in quick communication with each other, and with the users of their research.

A number of schemes for quick reporting from various central systems fell by the wayside until most persons concerned were ready to agree that the journal was after all a most efficient communication method for scientific information. It was not as generally appreciated then however, that quite good systems existed to handle journal articles, and in fact had functioned well for some time. On closer examination, and after comparison with really centralized systems, as in the USSR, it was found that the U.S. had some of the best indexing and abstracting services for the world scientific literature. It was interesting to see how many subscriptions went to countries with centralized services. Somewhat geared up and bolstered by computer techniques, to be sure, our scientific and technical information systems today appear to be working well, and furthermore, are published in the form of books. Documentalists, in the old days known to putter about in musty stacks, have refurbished their images and are now information systems specialists, and include tightly organized subsets of specialized researchers and technicians. No longer content with their former rear echelon roles, they now tell science much that it did not know about what information is, and what carefully designed systems can do with it.

The important point to me is that the "best" self-contained information system yet developed appears to be a well-organized book, combining compact size with instant accessibility, ease of reading, and a generally moderate cost.

On the bookshelf, volumes one through five measure nearly eleven inches; this is one of the few facts on the Bib that Wooster hasn't already provided in his prefaces. This size is still less than the smallest deskside computer console, or even the software program instructions for some information projects I have seen.

In these days of austere Air Force budgets for research, it is well to ensure that maximum effective use is being made of available resources. The Bibliography is a definite step in this direction, being the logical starting point in any search for research results from Air Force support The Bibliography has been made as useful an instrument as possible, and is distributed to key centers of scientific and technical documentation within the Air Force, the academic and industrial communities, and to selected libraries worldwide, especially in developing nations. Sales through Superintendent of Documents alone are impressive.

In his quest for better information packaging, Wooster laments the regrettable failure of engineers to develop a cuddly microfiche reader (2). This illustrates the truism that all kinds of requirements are imposed upon information systems, many of them unforeseeable by the designers of those systems. Every effort has been made to make the Bibliography useful and we would like to hear from the users how it is being used, how useful it is in present form, and how it could be improved. We are not looking for testimonials, although these do serve useful purposes in these days of increasing needs to justify and document research budget requests. We are especially interested in examples in which this reference service has been of assistance in effectively coupling research to application.

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

References

1. H. A. Wooster. Basic Research and the Department of Defense. Before Dallas Salesmanship Club, Dallas, Tex. 9 March 1967.

2. H. A. Wooster. Towards a Uniform Federal Report Numbering System and a Cuddly Microfiche Reader -- Two Modest Proposals Before Third Annual Northeastern DDC, Industry Users Conference, Waltham, Mass. 17 April 1968

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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 1962-1965.

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 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 to DDC form of entry 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, has been provided. In addition, there are a contract index, an AFOSR control number index, and a personal author index.

Acknowledgments

Many people 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, Jack L. Deets, and Ivan Atkinson; 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, Lt. Colonel Harry Jaffers. 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. Alex Nagy, chief designer, and staff artist Pat Shealy, of the Office of Aerospace Research, would have drawn the chapter and plates (if they had been permitted to do so).

Library of Congress, protocol dictates the form and order of acknowledgment of contributions made by LC staff members to a bibliography. Formally, the credit lines read as follows:

"The bibliographic team worked under the guidance and leadership of Dr. Clement R. Brown, Head of the Special Bibliographies Section, Science and Technology Division through December 1967. The chief bibliographers have been, Thomas C. Goodwin, Jr., Acting Head of the Special Bibliographies Section, G. Vernon Hooker, Supervisor of the Air Force Research Unit through February 1968, Doris C. Yates, Parthenia A. Patrick, Alexia H. Hatch, Joyce F. Lindsay, and Norman G. Lamb. A special note of gratitude is due to those who have aided in abstracting and typing, especially Jeanne D. Weber 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."

Informally, I feel a great loss in the retirement of Clem Brown, Scholar above and beyond anything that could be written in a job description, and Vernon Hooker, whose indefatigable bibliographic zeal set and sets a hard pace for younger men to follow. Si monumentum requiris, circumspice.



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

Arlington, Va.
August 1968

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ORTHOGONAL POLYNOMIALS IN 2 OR n VARIABLES, by T Busk. Annual summary rept. no. 3, Jan. 1-Dec. 31, 1962, 6p. (AFOSR-4713) (AF 61(052)322) AD 408381 Unclassified

This research has been concerned with the development of a general interpolation formula, valid for an arbitrary set of arguments and not only for arguments which are intersections of sets of parallel lines, and having the following properties: (a) the formula should be symmetric in the arguments, and (b) it should give reasonable results when applied to various special cases. A formula of this type, developed for n-point interpolation in functions of (n-1) variables, is the following:

$$f(X_0) = \sum_{s=1}^{n} \frac{X_1 X_2 \cdots X_{s-1} X_0 X_{s+1} \cdots X_n}{X_1 X_2 \cdots X_{s-1} X_s X_{s+1} \cdots X} f(X_s) ,$$

where the expressions in the fraction denote hypervolumes. While attempts to generalize the above formula to cover 4-point interpolation functions of 2 variables have proved unsatisfactory, more positive results have been obtained for the development of (1) an iterative method for the solution of n non-linear equations in n unknowns, and (2) an iterative method for the solution of an equation in one, complex variable.

2

Aarhus U. Mathematical Inst. (Denmark).

INVESTIGATIONS ON FLUCTUATIONS OF SUMS OF RANDOM VARIABLES, by E. S. Andersen. Aug. 16, 1961 [10]p. (Annual summary rept. no. 3) (AFOSR-2134) (AF 61(052)42) AD 272185 Unclassified

For symmetrically dependent random variables, a generalization of Spitzer's formula is derived. Furthermore, results on Toeplitz matrices and a Law on the Iterated Logarithm for Maximal Order Statistics are reported. (Contractor's abstract)

3

Aarhus U. Mathematical Inst. (Denmark).

CHARACTERISTIC SUBSEQUENCES AND LIMIT LAWS FOR WEIGHTED MEANS, by O. Barndorff-Nielsen. July 26, 1962 [15]p. (Technical note no. 6; rept. no. ASR 3) (AFOSR-3544) (AF 61(052)42) AD 285442 Unclassified

Also published in Trans. Third Prague Conf. on Information Theory, Statistical Decision Functions, Random Processes, Liblice [Czechoslovakia] (June 5-13, 1962), Prague, Czechoslovak Academy of Sciences, 1964, p. 17-27.

In proving limit theorems for sequences $\{Z_n\}$ of random variables, it is a standard method to choose a suitable subsequence $\{Z_{n_i}\}$ of $\{Z_n\}$, verify that if the theorem holds for the subsequence $\{Z_{n_i}\}$ then it holds for $\{Z_n\}$ (so that the subsequence is in a sense 'characteristic' for $\{Z_n\}$ with respect to the convergence property in question) and finally prove the theorem for $\{Z_{n_i}\}$. As a result of analyzing applications of this method, some elementary lemmas of analytic nature have been established which may be used to sharpen well known limit theorems in the theory of probability. This is illustrated by deriving strong laws of large numbers for weighted means of random variables which are either uniformly bounded or have uniformly bounded p-th (absolute) moments and by proving an extension of the arc sin law to certain sequences of nonidentically distributed random variables. (Contractor's abstract)

4

Aberdeen U. Dept. of Chemistry (Scotland)

CRYSTALLOGRAPHIC STUDY OF $Ca_2BaSi_3O_9$, by F. P. Glasser and L. S. D. Glasser. [1961] [3]p. incl. tables. (AFOSR-4066) [AF 61(052)276] Unclassified

Also published in Zeitschr. Krist., v. 116: 263-265, 1961.

For abstract see item no. 5, Vol. V.

5

Aberdeen U. Dept. of Chemistry (Scotland).

STRUCTURE OF CALCIUM ALUMINATE, $12CaO.7Al_2O_3$, by J. Jeevaratnam, L. S. D. Glasser, and F. P. Glasser. [1962] [2]p. (AFOSR-4068) [AF 61(052)276] Unclassified

Also published in Nature, v. 194: 764-765, May 26, 1962.

Observed intensity measurements of 56 x-ray reflections from a single crystal of anhydrous $12CaO.7Al_2O_3$ gave good agreement with intensities calculated from the proposed structure of Büssem and Eitel (Zeitschr. Krist., v. 95: 175, 1936). This structure with a = 11.98A, space group $I\bar{4}3d$, Z = 2, apparently leaves 2 "surplus" O ions per unit cell. The structure is being refined to locate these O ions. The high temperature hydrate (approx 12 $CaO.7Al_2O_3.H_2O$) is also being studied to locate the OH^- groups.

6

Aberdeen U. Dept. of Chemistry (Scotland).

THE DEHYDRATION OF HEMIMORPHITE, by H. F. W. Taylor. [1962] [13]p. incl. diagrs. table, refs. (AFOSR-4249) [AF 61(052)276] AD 405525 Unclassified

Also published in Amer. Mineralogist, v. 47: 932-944, July-Aug. 1962.

The thermal dehydration of hemimorphite ($Zn_4Si_2O_7(OH)_2 \cdot H_2O$) has been studied by single-crystal x-ray methods. Loss of the molecular water below 550°C causes only slight change in the rest of the structure. At about 700°C, the hydroxyl water is lost, and there is an oriented conversion to β-Zn_2SiO_4, below 960°C there is a second oriented conversion to α-Zn_2SiO_4 or willemite. γ-Zn_2SiO_4 does not appear to be formed. Both orientation relationships have been established and the unit cell of β-Zn_2SiO_4 is probably derived from a distorted tridymite- or cristobalite-like framework in which half of the silicon is replaced by zinc and additional atoms of zinc introduced into suitable interstices. Possible mechanisms for the 2 oriented conversions are discussed, and are compared with those known or believed to occur in similar reactions of silicates containing other cations. (Contractor's abstract)

7

Aberdeen U. Dept. of Chemistry (Scotland).

REACTIONS IN HEATED LIME-ALUMINA MIXTURES, by A. J. Williamson and F. P. Glasser. [1962] [4]p. incl. diagr. table. (AFOSR-J1083) [AF 61(052)276] AD 422284 Unclassified

Also published in Jour. Appl. Chem., v. 12: 535-538, Dec. 1962.

Results of heating 5 lime-alumina mixtures for 3—120 hr at temperatures from 1045° to 1405° are presented. The mixtures were prepared from mixtures of $CaCO_3$ (calcite) and α-Al_2O_3 and also from co-precipitated hydroxide gels. Significant departures from equilibrium were noted. In general the gel mixtures approached the equilibrium state more rapidly. Unstable $5CaO, 3Al_2O_3$ was not detected. Previous interpretations of x-ray diffraction patterns of heated lime-alumina mixtures are shown to be in error. The mechanism of the reaction cannot be uniquely determined from a study of the bulk reaction products. (Contractor's abstract)

8

Aberdeen U. Dept. of Chemistry (Scotland).

TOPOTACTIC REACTIONS IN INORGANIC OXY-COMPOUNDS, by L. S. D. Glasser, F. P. Glasser, and H. F. W. Taylor. [1962] [22]p. incl. illus. diagrs. tables, refs. (AFOSR-J1092) [AF 61(052)276] AD 420490 Unclassified

Also published in Quart. Rev., v. 16: 343-360, 1962.

In topotactic processes, a single crystal of a starting material is converted into a pseudomorph containing one or more products in a definite crystallographic orientation. For true topotaxy there must be some 3-dimensional correspondence between the structures of the product and its host, in contrast to epitaxy, in which the correspondence need only be 2-dimensional. Factors which may influence the degree of orientation include temperature, pressure, physical state, and time and rate of heating used to induce thermal changes. The sizes and electronegativities of the cations partly decide which ions move and which do not. With small cations, i.e., Mg^{2+}, Al^{3+}, Fe^{3+}, and Si^{4+}, the oxygen framework tends to stay relatively unchanged while cations migrate. The number of oxygen atoms in a given volume tends to remain constant in the regions where topotactic change occurs. At the other extreme, large electronegative cations, i.e., U^{4+} and Pb^{4+}, probably remain fixed while oxygen atoms move. In low-temperature reactions of hydrated calcium silicates, calcium migration is important, but reactions occurring above approx 500° take place mainly by migration of silicon, the Ca-O framework staying nearly unaltered. In high temperature reactions involving silicon, the concept of the silicate anion as the most important element of the structure is not a good starting point for an understanding of these reactions. The packing of oxygen atoms, and of any large cations present, is more important than that of silicon. Caution should be used in applying these generalizations to redox processes involving the metal, i.e., FeO - Fe, because it may be incorrect to use ionic radii. The effects of catalysts have been little studied. Water seems to catalyze silicon migration.

9

Aberdeen U. Dept. of Chemistry (Scotland).

CRYSTALLOGRAPHY OF THE $CaGa_2O_4$ POLYMORPHS, by J. Jeevaratnam, F. P. Glasser, and L. S. D. Glasser. [1961] [6]p. incl. tables. (AFOSR-64-0432) (AF 61(052)276) AD 436369 Unclassified

Also published in Zeitschr. Krist., v. 118: 257-262, June 1963.

Single crystals of the 3 polymorphs of $CaGa_2O_4$ have been studied. $CaGa_2O_4$-I is orthorhombic, with a = 7.73, b = 9.14, c = 10.36A; $CaGa_2O_4$-II is orthorhombic with a = 5.52, b = 14.38, c = 16.82A; m-$CaGa_2O_4$ is monoclinic with a = 7.86, b = 8.90, c = 10.55A, β = 93°. These cell dimensions do not resemble any of those previously reported for other $RO \cdot R_2O_3$ compounds. (Contractor's abstract, modified)

10

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

SUMMARY OF LOW TEMPERATURE PLASMA-JET RESEARCH, ENERGY TRANSPORT IN CHEMICALLY ACTIVE NONEQUILIBRIUM SUPERSONIC STREAMS, by D. E. Rosner. Final rept. Feb. 1962, 11p. incl. refs. (Rept. no. TP-39) (AFOSR-2202) (AF 49(638)-300) AD 273889 Unclassified

The abstracts of 17 reports and papers are given together with a chronological listing of 18 verbal presentations made under the same contract. These contributions deal with experimental and theoretical aspects of energy transport in chemically active, nonequilibrium gaseous streams and represent the results of a 4 yr program of research in this area. (Contractor's abstract)

11

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

CHEMICAL SCAVENGER PROBE DETERMINATIONS OF ATOM AND EXCITED MOLECULE CONCENTRATIONS IN NONEQUILIBRIUM SUPERSONIC STREAMS OF ACTIVE NITROGEN, by A. Fontijn, D. E. Rosner, and S. C. Kurzius. Aug. 1962 [60]p. incl. diagrs. tables, refs. (Rept. no. TP-40) (AFOSR-4626) (AF 49(638)300) AD 296398 Unclassified

A quartz chemical scavenger probe was developed to study local active species concentrations in a gas expanded from a converging-diverging nozzle glow discharge source. The probe samples a small central portion of the supersonic non-equilibrium jet. Results obtained with active N at one relatively low discharge power output are discussed. The sampled gas mixed and reacted inside the probe with one of the scavenger gases NO, NH_3, or C_2H_4 at 18.8 mm Hg and an average temperature of 500°K. The NO light titration technique and the production of HCN from C_2H_4 set an upper and lower bound respectively for the atom concentration. The observed maximum amount of NO decomposition was 2.1 times as large as the NO light titration end point flow rate. This difference is far in excess of that observed in conventional discharge flow systems and is interpreted as being due to excited N_2 molecules reacting with NO in a reaction slow compared to that between N-atoms and NO. The contribution of the jet was found to be at least comparable to that of the N-atoms. A new analytical technique for quantitative analysis of the undecomposed NO was developed. Decomposition of NH_3 also showed the presence of excited molecules. The NO light titration technique can also be used for composition measurements of the total supersonic jet. (Contractor's abstract, in part)

12

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

THE APPARENT CHEMICAL KINETICS OF SURFACE REACTIONS IN EXTERNAL FLOW SYSTEMS. DIFFUSIONAL FALSIFICATION OF ACTIVATION ENERGY AND REACTION ORDER, by D. E. Rosner. [1962] [11]p. incl. diagrs. tables, refs. (AFOSR-J1478) (AF 49-(638)1138) AD 426558 Unclassified

Also published in A.I.Ch.E. Jour., v. 9: 321-331, May 1963.

For abstract see item no. 14, Vol. V.

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

SCALE EFFECTS AND CORRELATIONS IN NONEQUILIBRIUM CONVECTIVE HEAT TRANSFER, by D. E. Rosner. [1962] [6]p. incl. diagrs. refs. (AFOSR-J1480) (AF 49(638)1138) AD 427536 Unclassified

Also published in AIAA Jour., v. 1: 1550-1555, July 1963.

The effect of chemical nonequilibrium on the dependence of heat flux on physical scale is illustrated for the case of simultaneous gas-phase and surface-catalyzed-atom recombination. Altitude-velocity regimes in which one can expect appreciable chemical nonequilibrium effects on the heat flux and its scale dependence are displayed and combined with trajectory information for representative hypersonic vehicles. Approximate but rather general correlation equations are suggested for the nonequilibrium boundary-layer regime.

14

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

FUNDAMENTAL SOLUTION TO THE DIFFUSION BOUNDARY LAYER EQUATION FOR SEPARATED FLOW OVER SOLID SURFACES AT VERY LARGE PRANDTL NUMBERS, by D. E. Rosner. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-J1481) (AF 49(638)1138) AD 427537 Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 6: 793-804, Sept. 1963.

For abstract see item no. 17, Vol. VI.

15

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

INFLUENCE OF THE TURBULENT DIFFUSION BOUNDARY LAYER ON THE APPARENT KINETICS OF SURFACE CATALYSED REACTIONS IN EXTERNAL FLOW SYSTEMS, by D. E. Rosner. [1962] 17p. incl. diagrs. tables, refs. (AFOSR-64-0215) (AF 49(638)-1138) AD 432574 Unclassified

Also published in Chem. Eng. Sci., v. 19: 1-17, Jan. 1964.

For abstract see item no. 18, Vol. VI.

16

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

RADIATION COOLING OF AERODYNAMICALLY HEATED SURFACES AT HIGH MACH NUMBERS, by D. E. Rosner. [1962] [44]p. incl. diagrs. tables, refs. (AFOSR-64-1893) (AF 49(638)1138) AD 450013 Unclassified

Also published in Supersonic Flow, Chemical Processes and Radiative Transfer; [Proc. AGARD Colloq.], ed. by D. B. Olfe and V. Zakkay. London, Pergamon Press, 1964. p. 439-485.

For abstract see item no. 19, Vol. VI.

17

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

FUNDAMENTAL SOLUTION TO THE DIFFUSION BOUNDARY LAYER EQUATION FOR NEARLY SEPARATED FLOW OVER SOLID SURFACES AT VERY LARGE PRANDTL NUMBERS, by D. E. Rosner. Nov. 1962, 74p. incl. diagrs. tables, refs. (Rept. no. TP-52) (AF 49-(638)1138) AD 291031 Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 6: 793-804, Sept. 1963. (AFOSR-J1481; AD 427537)

Using the method of self-similar solutions, an exact fundamental solution to the equation of convective diffusion is obtained for the case of nearly separated flow over a surface when the Prandtl number is very large compared to unity. The driving force for diffusion is assumed to change abruptly from zero to unity at the streamwise location $x = \xi$ and an arbitrary distribution of the velocity profile curvature parameter $(\delta^2 w / \delta y^2)_{y=0}$ is allowed through the use of the von Mises transformation. An integral (profile) method using a cubic polynomial for the dimensionless concentration (temperature) profile is shown to predict the correct functional form of transfer coefficient but overestimates its magnitude by 3.3%. This is more than twice the error of a corresponding integral method solution to the nonseparating flow problem, suggesting once again that for a given number of terms in the approximating polynomial the accuracy of profile methods in general deteriorates as one nears separation of the velocity boundary layer.

18

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

INFLUENCE OF THE TURBULENT DIFFUSION BOUNDARY LAYER ON THE APPARENT KINETICS OF SURFACE REACTIONS IN EXTERNAL FLOW SYSTEMS. by D. E. Rosner July 1962, 51p. incl. diagrs. tables, refs. (Rept. no. TP-50) (AF 49(638)1138) AD 291030 Unclassified

Also published in Chem. Eng. Sci., v. 19: 1-17, Jan. 1964. (AFOSR-61-0215, AD 432574)

The occurrence of diffusion boundary layers in the vicinity of solid catalysts in forced-flow systems causes the apparent chemical kinetics of surface reactions to differ from the true interfacial kinetics. The magnitude of this falsification is investigated quantitatively for the case of turbulent incompressible flow within the boundary layer, using the uniform catalytic flat plate as an example. Corresponding results for laminar diffusion layers are included for comparison. Several distinct computational techniques are discussed for diffusional Prandtl numbers of order unity as well as for the asymptotic extreme. Tabular values are given of all pertinent nondimensional reaction rate coefficients over the entire range from reaction rate-to-diffusion control for one-half, first and second order irreversible surface reactions using a rational improvement of the Frank-Kamenetskii quasi-stationary approximation.

19

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

RADIATION COOLING OF AERODYNAMICALLY HEATED SURFACES AT HIGH MACH NUMBERS, by D. E. Rosner. Jan. 28, 1962, 48p. incl. diagrs. tables, refs. (Rept. no. TP-60) (AF 49(638)1138) AD 297233 Unclassified

Also published in Supersonic Flow, Chemical Processes and Radiative Transfer; [Proc. AGARD Colloq.], ed. by D. B. Olfe and V. Zakkay. London, Pergamon Press, 1964, p. 439-483. (AFOSR-64-1893; AD 450013)

Several aspects of radiation cooling are discussed, particularly those associated with the occurrence of surface catalyzed atom recombination at high Mach numbers. An analogy between radiation cooling and chemical surface catalysis is explored and the dominant effects resulting from interactions between these two processes are illustrated using simple mathematical models which serve to single out the important nondimensional parameters. In connection with flight applications, altitude velocity maps are presented which provide an over-all picture of the regimes in which chemical nonequilibrium effects should be noticeable. Several unexplored areas of potential interest in the design of hypersonic lifting vehicles are outlined and related to the available literature. Not all of these areas deal with thermochemical effects. Many problems remain unsolved, as illustrated by a brief discussion of the radiation-cooled flat plate (Contractor's abstract)

20

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

SCALE EFFECTS FOR NONEQUILIBRIUM CONVECTIVE HEAT TRANSFER WITH SIMULTANEOUS GAS PHASE AND SURFACE CHEMICAL REACTIONS. APPLICATION TO HYPERSONIC FLIGHT AT HIGH ALTITUDES, by D. E. Rosner. Nov. 1962, 19p. incl. diagrs. refs. (Rept. no. TP-54) (AF 49(638)1138) AD 291052 Unclassified

Conceptual division of the general problem of nonequilibrium convective heat transfer into a transfer coefficient and generalized recovery enthalpy driving force fails to confine the dominant influence of fluid dynamic quantities to the coefficients themselves. The Reynold's number dependence of the energy transport rate can exhibit unusual behavior, particularly in the mixed regime in which strongly exothermic gas phase and surface atom recombination reactions are of comparable importance. A class of manned re-entry bodies will experience peak heating rates in altitude-speed

regions where nonequilibrium atom recombination will be the rule. Available calculations indicate that the peak heat flux could differ by a factor of three. A controllable trajectory which has been optimized on the basis of a convective heating rate may be significantly different from the true optimal trajectory taking due account of nonequilibrium phenomena. It has been conjectured that if nonequilibrium recombination were included in certain design calculations there might exist optimum nose radii for minimum heat flux somewhat in analogy to the more familiar case of combined convective and radiative heat transfer.

21

Aerojet-General Corp., Azusa, Calif.

ISOTOPE EFFECTS AND THE MECHANISM OF ATOM PRODUCTION IN GAMMA-IRRADIATED ICE AT 4.2°K, by H. S. Judeikis, J. M. Flournoy, and S. Siegel. [1962] [7]p incl. diagrs. table. [AF 18(603)-110] Unclassified

Published in Jour. Chem. Phys., v. 37: 2272-2278, Nov. 15, 1962.

The relative intensities of the electron spin resonance spectra of H and D atoms were determined for mixtures of H_2O and D_2O which were irradiated and observed at 4.2°K. A careful analysis of the results indicates that the yield of atoms per unit irradiation dosage exhibits no isotope effect, except for the system containing trace amounts of H_2O in D_2O. The presence of a large isotope effect for a system of D_2O containing approximately 0.1% H_2O is discussed in terms of energy transfer in the solid state. (Contractor's abstract)

22

Aerojet-General Corp., Azusa, Calif.

HIGH FREQUENCY COMBUSTION INSTABILITY (Abstract), by R. G. Peoples. [1961] [1]p. [AF 49-(638)178] Unclassified

Presented at Fourteenth AFOSR Contractors' meeting on Liquid Rocket Combustion Research, Princeton U., N. J., Sept. 25-26, 1961. (AFOSR-1768; AD 267915)

It has been demonstrated that the inherent stability of a combustion process, as related to basic rocketry, is determined by (a) the magnitude and spatial distribution of pressure-sensitive energy available for release to a given perturbation, and (b) the relationship between the replenishment of this energy and the behavior characteristics of the perturbation. Recent activities have been directed towards the quantitative investigation of the parameters affecting inherent stability. A 2-dimensional, transparent-walled motor was designed, fabricated, and tested to experimentally measure pressure-sensitive energy and to determine the effect of variations in the operating parameters on the magnitude and spatial distribution of this energy. The combustion mechanism is photographically observed to determine gas velocity and relative combustion temperature, and as a result, available energy is determined. Representative experimental data is presented and discussed. The support mechanism for combustion instability and the characteristic behavior of a perturbation have an interdependency which must be considered when investigating either phenomena. The difficulties encountered thus far in the development of an experimentally consistent theory for unstable combustion have been the result of analytical separation of these events. To overcome some of the deficiencies of existing analytical combustion models, the characteristics of an instability, as encountered in a large-scale thrust chamber, are being investigated. Some of the pertinent information gathered is presented and discussed.

23

Aerojet-General Corp., Azusa, Calif.

KINETICS OF RECOMBINATION PROCESSES, by C. B. Kretschmer. Final technical rept. Apr. 15, 1959-June 14, 1962, 24p. incl. tables. (Rept. no. AN-671) (AFOSR-3200) (AF 49(638)540) AD 283043 Unclassified

Rate coefficients for formation of N_2, NO, H_2, HO_2, H_2O_2, He_2^+, and Ar_2^+ from atoms, atomic ions, or free radicals in triple collisions were measured at 300°K. A theoretical evaluation of the rate coefficient for diatomic molecule formation in triple collisions was carried out, giving results which agreed well with the experimental values. Rate coefficients for several bimolecular reactions involving O atoms, N atoms, or OH radicals were also determined. A theory of positive ion collection by Langmuir probes in gas discharge plasmas at pressures between about 0.1 and 20 mm Hg was developed. Dissociative recombination coefficients of Ar, N, O, Hg, and Cs molecular ions were determined from probe measurements on gas discharge afterglows, using this theory to calculate ion concentrations from probe currents. Recombination coefficients obtained in this manner agreed well with values obtained by microwave techniques. (Contractor's abstract)

24

Aerojet-General Corp., Azusa, Calif.

KINETICS OF THREE-BODY ATOM RECOMBINATION, by C. B. Kretschmer and H. L. Petersen. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0666) (AF 49-(638)540) AD 435933 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1772-1778, Oct. 1, 1963.

For abstract see item no. 26, Vol. VI.

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Aerojet-General Corp., Azusa, Calif.

USE OF LANGMUIR PROBES TO STUDY ION-ELECTRON RECOMBINATION, by C. B. Kretschmer and

H. L. Petersen. [1962] [9]p. incl. diagrs. table, refs. (AFOSR-64-0667) [AF 49(638)540] AD 435912
Unclassified

Also published in Jour. Appl. Phys., v. 34: 3209-3217, Nov. 1963.

For abstract see item no. 27, Vol. VI.

26

Aerojet-General Corp., Azusa, Calif.

KINETICS OF THREE-BODY ATOM RECOMBINATION, by C. B. Kretschmer and H. L. Petersen. June 1962, 22p. incl. illus. tables, refs. (Rept. no. AN-625) (AF 49(638)540) AD 283042 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1772-1778, Oct. 1, 1963. (AFOSR-64-0666; AD 435933)

The following values of the 3-body recombination rate constant in units of $cc^2/mol^2 sec$ were measured at 300° or 350°K:

$$N + N + N_2 \rightarrow N_2 + N_2,\ 8.0 \times 10^{14},$$

$$N + O + N_2 \rightarrow NO + N_2,\ 3.3 \times 10^{15},$$

$$H + H + H_2 \rightarrow H_2 + H_2,\ 8.9 \times 10^{15}.$$

The rate constant for the reaction $N + O_2 \rightarrow NO + O$ was found to be 5×10^7 cc/mol sec at 350°K. A statistical-mechanical calculation of the 3-body recombination rate constant gave values which agreed well with the above experimental results and also reproduced the previously determined value of $< 2.5 \times 10^{14}$ cc^2/mol^2 sec for $O + O + O_2 \rightarrow O_2 + O_2$. The large variation in rate constant for different gases is due mainly to differences in atomic masses and statistical weights. Redissociation of molecules in high vibrational levels is important in reducing the net rate of recombination. At high temperatures, the theory predicts a rate constant varying as T^{-1}.

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Aerojet-General Corp , Azusa, Calif.

THE USE OF LANGMUIR PROBES TO STUDY ION-ELECTRON RECOMBINATION, by C. B. Kretschmer and H. L. Petersen. July 1962, 36p. incl. diagrs. table, refs. (Rept. no. AN-664) (AF 49(638)540) AD 283041 Unclassified

Also published in Jour. Appl. Phys., v. 34: 3209-3217, Nov. 1963. (AFOSR-64-0667; AD 435912)

Between about 0.1 and 20 mm Hg, ion concentration is related to the current collected by a negative cylindrical probe by the equation (in practical units)

$$n = 1.78 \times 10^{12} \lambda_e^{-1} \alpha^{-5/8} (V_p r_p)^{-1/4} i^{5/8},$$

where λ_e is the electron mean free path, α is the ion mobility, V_p and r_p are the probe voltage and radius, and i is the probe current per unit length. The plasma is not perturbed because the probe current is supplied by ionization occurring at the sheath boundary. Using this equation, the following values of the dissociative-recombination coefficient α in cm^3 sec were obtained from pulse discharge afterglow measurements: argon, 3.6×10^{-7} for high excitation and 1.4×10^{-6} for moderate excitation; oxygen, 2.0×10^{-6}; mercury, 3.5×10^{-6}. For nitrogen α was found to be proportional to pressure and equal to 1.7×10^{-7} at 1 mm Hg. For cesium the above equation does not apply, and the value $\alpha = 1.7 \times 10^{-7}$ was obtained from experimental results using conventional probe theory. The frequency of 3-body conversion of atomic to molecular ions was found to be 151 sec^{-1} for argon and 37 sec^{-1} for helium. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

AN INVESTIGATION OF A CHARGED COLLOID PROPULSION SYSTEM, by C. K. Hinrichs. Final technical rept. May 1959-July 1962, 49p. incl. illus. diagrs. refs. (Rept. no. AN-683) (AFOSR-3202) (AF 49(638)656) Unclassified

The electrostatic dispersion of low vapor pressure liquids into highly-charged colloidal particles has been studied with a view to the application of this process in a charged colloid propulsion system for space applications. The liquids were dispersed from various spray tips that were raised to a high electric potential. The atomization of the liquids into charged colloidal particles can be explained by the repulsion of charges on the liquid surface by the high potential of the spray tip. Two methods of charging the liquid have been studied—electron bombardment and ionic conduction. In the absence of these charging methods the liquid does not form a colloidal spray but does undergo a pumping action which may be explained by the weaker effects of dielectrophoresis. Charge-to-mass ratio distributions for the droplets in the spray have been obtained that have average charge-to-mass ratios varying from .1 coulomb kg to 40 coulombs kg. The average charge-to-mass ratio obtained was found to increase with increasing conductivity or spraying voltage or decreasing mass flow rate. It is expected that the application of these effects can increase the charge-to-mass ratio to several hundred to a thousand coulomb kg and make the technique of electrostatic dispersion of liquids applicable to charged colloid propulsion systems.

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Aerojet-General Corp , Azusa, Calif.

RATE OF SUBLIMATION OF AMMONIUM HALIDES, by R. F. Chaiken, D. J. Sibbett and others. Mar. 1962 [24]p. incl. diagrs. tables, refs. (Rept. no. TN-43) (AFOSR-2350) (AF 49(638)851) AD 407709, AD 609814 Unclassified

Also published in Jour. Chem. Phys., v. 37 2311-2318, Nov 15, 1962.

The rates of sublimation of ammonium chloride, bromide, iodide, and fluoride have been determined by 2 different techniques over the temperature range of 100-600°C, corresponding to an increase in sublimation rate of 10^4 The 2 methods employed were the isothermal rate of weight loss using a quartz spring balance, and the hot-plate linear pyrolysis method. The low activation energy (about one-third the heat of sublimation) found for ammonium chloride by earlier investigators has been verified and found to extend to the other halides. The frequency factor is also abnormally low for the ammonium halides, by a factor of roughly 10^4, with the exception of fluoride, for which the factor is only about 500. These results are in fair agreement with the Schultz-Dekker mechanism for ammonium halide sublimation. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

INVESTIGATIONS OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION AND DETONATION OF SOLIDS (Abstract), by R. F. Chaiken, D. J. Sibbett and others. [1961] [2]p. [AF 49(638)851] Unclassified

Presented at Third AFOSR Contractors' Meeting on Combustion of Solid Propellants, Utah U., Salt Lake City, Jan. 30-31, 1961. (AFOSR-986)

Brief progress is reported on the following studies: (1) rates of sublimation for NH_4Cl, NH_4Br, and NH_4I; (2) thermal decomposition of small single crystals of ammonium perchlorate; (3) grain burning detonation of explosives (TNT, Tetryl, and PETN); (4) burning rate studies of pressed strands of propellant materials, and (5) the gas phase decomposition of perchloric acid.

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

A NEW APPROACH TO NONEQUILIBRIUM STATISTICAL MECHANICS OF GASES, by J. E. McCune, G. Sandri, and E. A. Frieman. [1962] [13]p. incl. refs. (AFOSR-3718) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1140 and Office of Naval Research) AD 287145 Unclassified

Also published in Rarefied Gas Dynamics Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v 1: 102-114, 1963. (AFOSR-5312)

A new technique for the study of multiple-time relaxation processes is applied to the case of a short-range (neutral) dilute gas. A virial expansion of the BBGKY hierarchy is combined with an expansion of the time derivative in such a way that explicit account is taken of both the fast and slow processes occurring. This expansion is made definite by the removal of secular terms on the fast time scale; the first condition for the removal of such secularities is Bogolubov's form of the Boltzmann equation. Generalized conditions for the attainment by a gas of such a kinetic stage are given. The difficulty of generalizing the kinetic equation to allow for 3-body effects is discussed in the light of new developments. (Contractor's abstract)

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

ON THE RELAXATION OF GASES TOWARD CONTINUUM FLOW, by J. E. McCune, T. F. Morse, and G. Sandri. [1962] [21]p. incl. diagr refs. (AFOSR-J1038) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1140 and Office of Naval Research) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 1: 115-135, 1963. (AFOSR-5310)

A new method for obtaining kinetic equations from expansions of the BBGKY hierarchy has been developed recently by Frieman and Sandri. This method takes advantage of the multiplicity of time scales appearing naturally in the hierarchy equations, and uses the freedom of these new time parameters to eliminate secular terms and thereby render the expansion uniformly valid for all times. The technique of introducing multiple time scales is also applicable to the Boltzmann equation and its various moments. For a perturbation in small spatial gradients at fixed Mach number it is shown that the second and third approximations to the distribution function necessarily must approach asymptotically the familar Chapman-Enskog results if the expansion is to remain valid for large times. The moment equations asymptotically become the Navier-Stokes and Burnett equations in the corresponding approximations. This pattern follows to all orders. The major new result is to demonstrate the manner in which the various approximations to the distribution function asymptotically approach the Chapman-Enskog values on the fast time scale. To study in detail how this asymptotic damping of transients occurs, the Bhatnager, Gross, Krook collision model is investigated, and explicit forms of the transients in the pressure tensor and heat flow vector calculated through first order. (Contractor's abstract)

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

THE FOUNDATIONS OF NONEQUILIBRIUM STATISTICAL MECHANICS, I AND II, by G. Sandri. [1962] [86]p. incl. diagrs. tables, refs. (AFOSR-64-0136) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1224 and AF 49(638)1140, and Office of Naval Research) AD 431068 Unclassified

Also published in Ann. Phys., v. 24: 332-418, Oct. 1963.

A novel philosophy of irreversible dynamics is

formulated. This philosophy stems from the claim that the kinetic equations available (Boltzmann, Landau' Bogoliubov-Lenard) are essentially exact and cannot be improved. That is, for kinetic gases (those whose behavior is characterized by that of one typical particle) these equations constitute closed, statistically complete knowledge. This thesis is demonstrated by using a technique that separates completely the different time components exhibited by the evolution of a gas when an appropriate parameter (characteristic of the regime in which the gas is found) is small. The expansion in this parameter is pushed up to its breaking point marked by the presence of an intrinsic divergence. With this technique we can pinch off the series at this point and remain with a closed, finite system of equations. The argument is made compelling by the fact that the same divergence occurs for all gaseous regimes (short-range, weak-coupling, dilute weak-coupling and Debye). When statistical information about a gas is needed beyond that afforded by the knowledge of the motion of the average particle, a new asymptotic expansion of the Liouville equation must be used. For this purpose a pair-kinetic expansion of the Liouville equation is introduced.

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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. (AFOSR-3438) (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.

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

For abstract see item no. 39, Vol. IV.

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Aeronautical Research Inst. of Sweden, Stockholm.

RESEARCH ON THREE DIMENSIONAL FLOW EFFECTS ON THIN WINGS, by G. Drougge. [Final rept.] Nov. 20, 1962. 5p. incl. refs. (AFOSR-4586) (AF 61(052)75) AD 401177 Unclassified

A summary is presented of research on the 3-dimensional effects, at high supersonic speeds on thin wings due to the presence of another body, generally one to which the wing is attached. The problems studied were the second order wing-body interference and entropy gradient effects that are experienced by wings situated, for example, in the rotational flow field about a blunt-nosed body. (Contractor's abstract)

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Aeronautical Research Inst. of Sweden, Stockholm.

AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF SECOND-ORDER WING-BODY INTERFERENCE AT HIGH MACH NUMBER, by P. G. Wilby. Aug. 1962, 16p. incl. illus. diagrs. (Technical note no. 6, rept. no. 91) (AFOSR-4587) (AF 61(052)75) AD 294411 Unclassified

The second-order wing-body interference theory of Landahl and Beane is used in the theoretical calculation of the pressure distributions over the wing of a wing-body combination. Results are compared with experimental values obtained from wind-tunnel tests, at a Mach number of 7.35, on a cone-cylinder non-lifting body with a triangular wing of wedge section set at incidences of 0°, 3°, 6° and 10°. It is shown that interference effects can be very large and can be calculated theoretically with good accuracy. (Contractor's abstract)

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Aeronautical Research Inst. of Sweden, Stockholm.

THE FLOW FIELD ABOUT A HEMISPHERE-CYLINDER BODY AT A MACH NUMBER OF 7.3, by P. G. Wilby. Nov. 1962, 14p. incl. illus. diagrs. tables. (Technical note no. 7; rept. no. 92) (AFOSR-4588) (AF 61(052)75) AD 298668 Unclassified

A method is presented for evaluating the flow field around a blunt-nosed body of revolution, from stagnation pressure measurements and bow-shock shape. Results obtained by applying this method to a hemisphere-cylinder body at a Mach number of 7.3 are given and compared with results given by approximate theory. (Contractor's abstract)

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[Aeronca Manufacturing Corp. Aerospace Div., Baltimore, Md.]

ON EXISTENCE AND ON-LINE COMPUTABILITY OF MINIMAL-COST TIME-VARYING GAIN FACTORS OR OPEN-LOOP CONTROL PROGRAMS FOR FINAL-VALUE AUTOMATIC CONTROL SYSTEMS, by R. W. Bass. [1962] [11]p. (AFOSR-1559) [AF 49(638)1003] Unclassified

Let A(t) and K(t) be continuous matrices defined on $0 \le t < +\infty$, and let $0 \le \tau < T$ be any two times. Let x_0 be any vector in E^n, and define x(t) on $\tau \le t \le T$ by $\dot{x} = A(t)x + K(t)c(t)$, $x(\tau) = x_0$, where the "control function" c(t) is any measurable function defined on $\tau \le t \le T$ and such that the "cost of control" integral $I = I(c) = \int_\tau^T c(\sigma)^2 \, d\sigma$ if finite. Based on the above theorem, the following problems are considered: (1) that of finding a control law c(t) such that $x(T) = 0$, and (2) linear feedback control where $c(t) = G(t)x$ and

the gain matrix is any measurable function defined on $\tau \leq t \leq T$ such that $x(T) = 0$ holds and

$$\int_\tau^T G(\sigma)\, x(\sigma)^2\, d\sigma \text{ is finite.}$$

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Aeronca Manufacturing Corp. Aerospace Div., Baltimore, Md.

ASPECTS OF GENERAL CONTROL THEORY, by R. W. Bass and P. Mendelson. Aug. 1962. 187p. (AFOSR-2754) (AF 49(638)1003) AD 289486 Unclassified

An elaborate matrix analysis is developed for use as an effective technique for performing the numerical calculations necessary for application of advanced control theory to practical engineering. These new techniques have been applied successfully to a variety of multi-dimensional linear and non-linear control synthesis problems. A number of necessary and sufficient conditions for the stability of linear control system systems have been developed, using Liapunov's direct method, and have been used to derive several synthesis procedures for the selection of gain vectors ensuring stability. It is shown that if a linear system with one undetermined gain vector satisfies a so-called condition of "controllability", then for every possible choice of characteristic roots of the system, there exists precisely one gain vector, which, if chosen, causes the system to have the chosen roots. Further it is shown how this gain vector can be computed directly by a single matrix inversion. Among other topics discussed are: continuous saturating control systems, discontinuous on-off control systems, general nonlinear systems, discontinuous time-optimal control of linear plants, and the maximum principle for synthesis of optimal systems.

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Aeronutronic, Newport Beach, Calif.

[ELECTRON-ION RECOMBINATION BY COLLISIONAL AND RADIOACTIVE PROCESSES] by S. R. Byron, A. L. Kleider, and W. W. Lawrence. Second Annual rept. Jan 1962, 26p. incl. illus. diagrs. refs. (AFOSR-2229) (AF 49(638)670) Unclassified

Experimental measurements of the time history of the speed of shock waves generated in the T-tube are presented. The results of studies of the physical properties of high temperature gases under conditions far from equilibrium and studies of the ionization and radiative emission from the quiescent gas prior to passage of the shock wave in the T-tube are given.

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Aeronutronic, Newport Beach, Calif.

ELECTRON-ION RECOMBINATION BY COLLISIONAL AND RADIATIVE PROCESSES, by S. [R.] Byron, R. C. Stabler, and P. I. Bortz. [1962] [4]p. incl. diagrs. tables, refs. (AF 49(638)670) Unclassified

Published in Phys. Rev. Ltrs., v. 8, 376-379, May 1, 1962.

Two physical principles which dominate the electron-ion three-body recombination process of capture into excited states are pointed out and discussed. These principles are used as the basis of a simple general theory for the calculation of the electron temperature and the net rate three-body recombination, α. This theory is used to calculate the value of α in hydrogen at an electron temperature of 16000°K, the result agrees very well with that obtained from the computer program of Bates and Kingston. Calculations of α for several other cases are in general agreement with experiment.

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Aeronutronic [Newport Beach, Calif.]

ELECTRON-ION RECOMBINATION IN DISCHARGE AFTER-GLOWS (Abstract), by S. [R.] Byron, R. C. Stabler, and P. [I.] Bortz. [1962] [1]p. [AF 49(638)-670] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 328, Apr. 23, 1962.

The rate-limiting factors in the collisional recombination of electrons and ions in discharge afterglows are (1) the rate of de-excitation by collisions and radiation of the state for which the total equilibrium de-excitation rate has a minimum, and (2) the rate of elastic energy transfer between electrons and ions. The nonequilibrium electron temperature and the recombination rate are obtained from simultaneous solution of the equations for the minimum de-excitation rate and the electron energy balance. The 3-body character of the collisional recombination and de-excitation process is masked by the time rate of change of the electron temperature. The net rate of recombination exhibits a 2-body density dependence ($dN_e/dt = \alpha N_e^2$, where α is independent of N_e) because of the 2-body behavior of the elastic-energy transfer rate. Early results of the application of this theory to recombination in discharge afterglows are given in the following:

Gas	T_e(exp)[1]	N_e	α (th)	α(exp)[1]
argon	3100	3×10^{12}	2×10^{-10}	2×10^{-10}
cesium	2000	5×10^{12}	4×10^{-10}	3.4×10^{-10}
mercury	2000	10^{12}	3×10^{-10}	2.3×10^{-10}

43

Agricultural Research Council. Inst. of Animal Physiology [London] (Gt. Brit.).

EFFECT OF DRUGS ON THE NORADRENALINE CONTENT OF BRAIN AND PERIPHERAL TISSUES

AND ITS SIGNIFICANCE, by S. Sanan and M. Vogt. [1961] [19]p. incl. tables, refs. (AFOSR-3463) (AF 61-(052)367) Unclassified

Also published in Brit. Jour. Pharmacol. and Chemotherapy v. 18: 109-127, Feb. 1962.

A study was made of the changes in the noradrenaline content of sympathetic ganglia and brain produced by a series of drugs. The first section deals with drugs which have pharmacological actions on different parts of the postsynaptic sympathetic neurones. Two of these drugs, methoserpidine and guanethidine, cause hypotension, and the question arose whether this effect can be explained by changes in the noradrenaline content of the peripheral sympathetic neurones. A second point was to ascertain whether these drugs have any action on the brain. The actions of the 2 other drugs, the nicotine-like compound dimethylphenylpiperazinium iodide, which stimulates sympathetic ganglia, and amphetamine, which stimulates nerve endings, were examined. If this stimulation was accompanied by a loss in noradrenaline from the sympathetic neurone this would support the theory that these substances act by releasing noradrenaline. The second part of this work is concerned with 2 amine oxidase inhibitors known or reputed to raise the noradrenaline content of tissues, particularly of brain; the object was to test whether there is a correlation of such action with effects on behavior.

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Agricultural Research Council. Inst. of Animal Physiology [London] (Gt. Brit.).

CHEMICAL AND PHYSIOLOGICAL CHANGES PRODUCED BY ARTERIAL INFUSION OF DIHYDROXYPHENLALANINE INTO ONE CEREBRAL HEMISPHERE OF THE CAT, by R. Dagirmanjian, R. Laverty and others. Jan. 10, 1962 [10]p. incl. tables, refs. (AFOSR-3912) (AF 61(052)367) AD 289865 Unclassified

Also published in Jour. Neurochem. v. 10: 177-182, Mar. 1963 (AFOSR-J843, AD 416500)

Dihydroxyphenylalanine (DOPA), 5 – 20 mg, was infused into one carotid artery of the cats through a catheter tied into one lingual artery. When dilation of the pupil (anaesthetized cats) or encephalographic arousal (cerveau isole preparation) had developed on the side, of the infusion, the brain was removed and catecholamine estimations were carried out in different regions of the 2 cerebral hemispheres. The dopamine content of the caudate nucleus was increased on the side of the infusion, often by more than 100%. The dopamine content of hypothalamus and midbrain-reticular formation of the treated side was increased by a similar proportion. The noradrenaline content of the hypothalamus and the midbrain was not raised by the infusion. The possible relationship of chemical and physiological changes elicited by the infusion is discussed. (Contractor's abstract)

45

Agricultural Research Council. Inst. of Animal Physiology, London (Gt. Brit.).

HYPOGASTRIC NERVE OF THE DOG, by M. Vogt. [1962] [2]p. (AFOSR-J472) [AF EOAR-62-19] AD 407891 Unclassified

Also published in Nature, v. 197: 804-805, Feb. 23, 1963.

Longitudinal serial sections were made of the inferior mesenteric ganglia and the hypogastric nerves of dogs in an effort to ascertain where chromaffine tissue, if such was present, might be localized in such nerves. Analysis of the tissues revealed large chromaffine bodies inside the inferior mesenteric ganglia, but these did not extend into the hypogastric nerve. However, small elongated groups of 5-50 chromaffine cells occurred either within the very core of the nerve or along its surface underneath the epineurium. These groups were usually found in the middle part of the nerve, 2 or more cm away from either the lower pole of the mesenteric ganglion or the beginning of the pelvic plexus. There was no apparent difference in the amount of chromaffine tissue in the nerves of young and of adult dogs. In view of the present interest of pharmacologists in the hypogastic nerve, the fact should be kept in mind that this nerve is a complex structure, varying in composition from species to species, and not just a bundle of postganglionic fibres.

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Agricultural Research Council. Inst. of Animal Physiology, London (Gt. Brit.).

CHEMICAL AND PHYSIOLOGICAL CHANGES PRODUCED BY ARTERIAL INFUSION OF DIHYDROXYPHENYLALANINE INTO ONE CEREBRAL HEMISPHERE OF THE CAT, by R. Dagirmanjian, R. Laverty and others. [1962] [6]p. incl. tables, refs. (AFOSR-J843) [AF EOAR-62-19) AD 416500 Unclassified

Also published in Jour. Neurochem., v. 10: 177-182, Mar. 1963.

For abstract see item no. 44, Vol. VI.

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Agricultural U., Wageningen (Netherlands).

STRONGLY CAROTENOID-DEFICIENT CHROMATIUM-STRAIN D CELLS WITH 'NORMAL' BACTERIOCHLOROPHYLL ABSORPTION PEAKS IN THE 800-850 mμ REGION, by E. C. Wassink and G. H. M. Kronenberg. [1962] [2]p. incl. diagrs. (AFOSR-4183) (AF 61(052)-270) AD 632074 Unclassified

Also published in Nature, v. 194: 553-554, May 12, 196.

Cultures of carotenoid-deficient cells of Chromatium, strain D were prepared by the method devised by Goodwin and Osman, using diphenylamine (DPA). The bacteriochlorophyll absorption max at 850 mμ is of the same order of magnitude, and in some cases even higher than that found in normally grown cells of Chromatium, strain D. The same holds for the pigment-protein complexes, present in extracts of both types, prepared by grinding. In all cases the spectrum shows the shape which is usual for Chromatium, strain D, namely, with an 850 mμ max about 1.2—1.5 times as high as the 800 mμ max. The spectra of the green cells and their extracts tend to show a somewhat decreased 890 mμ absorption as compared with normally grown cells. Observations demonstrate that there is not necessarily a relation between disappearance of carotenoids and disappearance of the 850 mμ bacteriochlorophyll max in Chromatium, strain D.

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Agricultural U., Wageningen (Netherlands).

PHYSICAL AND CHEMICAL STUDIES OF CHLOROPHYLL SYSTEMS, by E. C. Wassink and G. H. M. Kronenberg. July 1, 1962 [160]p. incl. diagrs. refs. (AFOSR-4904) (AF 61(052)270) AD 414936 Unclassified

Study has been made of the absorption spectra of bacteriochlorophyll types in purple sulphur bacteria, as manifest by (often 3) absorption maxima in the near infrared (at 800, 850, and 890 mμ). Evidence for considering these absorption maxima as due to 3 or more different pigment-protein complexes is discussed. Preliminary attempts to separate these supposed complexes in their native state by dispersing and topographical methods proved ineffective. Further characterization of the pigment complexes in their native state was made by studying certain effects on harvested cells and during growth of cultures. The main effects considered were light intensity and light quality, temperature, atmosphere, cultivation with diphenylamine, depressing carotenoid formation, and a comparison between differential effects and the extractability of bacteriochlorophyll from the different complexes by organic solvents with variation in concentration and duration of exposure. In general the 850 mμ peak appeared more sensitive than the 800 mμ one. Preliminary observations suggest that the effect of red light, only absorbed by bacteriochlorophyll, is about as effective as that also absorbed by carotenoids.

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

ELECTRIC PROPULSION RESEARCH (SURVEY), by O. A. Berthold and M. W. Slawsky. May 8, 1961 [37]p. incl. tables. (AFOSR-1632) AD 264767 Unclassified

A comprehensive survey and analysis is presented of the research efforts being conducted by organizations of the Office of Aerospace Research, United States Air Force which are considered relevant to the over-all Air Force program of research in electric propulsion. The List of Research Efforts is separated into 2 major groups based on the degree of relevance to the Electric Propulsion Program. Group 1 includes those efforts which directly contribute to the electric propulsion work as such. Group 2 comprises the balance of the selected research efforts which contribute somewhat less directly to electric propulsion, but which are still positively related to it. (Contractor's abstract)

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

GAS-SURFACE PHENOMENA, by M. Rogers. Apr. 1962, 139p. incl. illus. diagrs. table, refs. (AFOSR-2342) (In cooperation with Johns Hopkins U., Baltimore, Md.) AD 285845 Unclassified

Presented at meeting on Gas-Surface Phenomena, Air Research and Development Command Hq., Baltimore, Md., Mar. 5, 1956.

This report is based on a transcript of an informal discussion which brought together scientists from the various disciplines (e.g., fluid dynamics, chemistry, and solid state physics) for an exchange of ideas on new concepts in gas-surface phenomena. The main topics of discussion were: Historical perspective and orientation, Viewing the surface, Surface lattice perfection and symmetry; Surface layers; Gas state and flow instability, Energy considerations in gas-surface interactions, The accommodation coefficient, Effect of relative masses and molecular structure on the thermal energy accommodation coefficient, Solid-solid adhesion and Conclusions and recommendations. It was concluded that advances in understanding gas-surface phenomena depend on advances in surface physics and chemistry. Since knowledge of the nature of, and details of, a surface is of interest to many diverse fields, a common forum for the presentation and collection of this knowledge appears warranted. It is therefore recommended that a Journal of Surface Physics be created, so that understanding and perspective obtained in any one area concerned with the problem can be rapidly and efficiently applied in the others.

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

LONG RANGE RESEARCH IN INFORMATION RETRIEVAL, by H. [A.] Wooster. [1962] [16]p. incl. tables. (AFOSR-4573) AD 428356 Unclassified

Also published in Information Retrieval Today; [Proc. of a Symposium], Minnesota U., Minneapolis (Sept. 19-22, 1962), ed. by W. C. Simonton. Minneapolis, Center for Continuation Study of Minnesota U., 1963, p. 149-164.

This paper is based on a National Science Foundation publication, Current Research and Development in Scientific Documentation, no. 10, dated May 1962, which is considered a valuable tool to those running research programs in the field of information retrieval.

In the 4 yr from Oct. 1958 to Nov. 1962 the publication grew from 76 pages with a total of 55 items to 383 pages with a total of 343 items. In the present note the various chapters are reviewed and analyzed individually, and categorized on the basis of the sources sponsoring research in the particular field covered by a given chapter. The discussions cover the following chapter headings: (1) Information needs and uses, (2) Information storage and retrieval, (3) Mechanical translation, (4) Equipment, (5) Character recognition, (6) Speech analysis and synthesis, (7) Linguistics and lexicography, and (8) Artificial intelligence.

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

LONG-RANGE RESEARCH IN INFORMATION SCIENCES, by H. [A.] Wooster. [1962] [7]p. (AFOSR-5535) Unclassified

Also published in Information Retrieval in Action; Proc. of a Conf., Western Reserve U., Cleveland, Ohio (Apr. 16-18, 1962), Cleveland, Western Reserve U. Press, 1963, p. 147-153.

The programs, responsibilities, and problems of the Air Force Office of Scientific Research in its role of supporting basic research and promoting accessibility of information concerning its research are discussed. It is suggested that fund-granting agencies should recognize 2 major responsibilities: (1) to report on the inventory of current projects that they are supporting, and (2) to make the results of the research freely available. Two major contributions of the Air Force in this area are publication of Basic Research Resumes, which contains one-paragraph abstracts of all AFOSR and Office of Aerospace Research supported projects; and the Air Force Scientific Research Bibliography, which gives abstracts of every report, journal article, symposium paper, etc., resulting from research supported by AFOSR and published during a given period. Commensurate with its basic research program, the Air Force must be concerned with the storage and retrieval of all forms of information, as well as the methodology and techniques necessary for the acquisition, transmission, evaluation, and interpretation of information. It is suggested that the groundwork be laid for using the great potential of computers in real time command and control operations, decision-making, advanced communication and intelligence processing problems.

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Air Force Office of Scientific Research. Directorate of Information Sciences, Washington, D. C.

THE AFOSR PROGRAM IN INFORMATION SYSTEMS RESEARCH, by R. Swanson. [1962] [10]p. incl. illus. refs. (AFOSR-4602) Unclassified

Also published in Proc. Symposium on Materials Information Retrieval, Wright-Patterson Air Force Base, Ohio (Nov. 28-29, 1962), p. 116-124.

The AFOSR program in information systems research is directed toward the support of fundamental studies having the promise of yielding general principles capable of being applied to information systems for specific purposes with profit to those systems. This program incorporates both empirical and theoretical studies ranging from systems analyses and ad hoc structuring of classification schedules to inquiries into the elements of language, human thought and learning processes, and logic systems for machine reduction — all aimed ultimately toward the better information system, the better concatenation of men and machines to facilitate progress in the advancement and applications of knowledge.

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

NOTES ON TEST SLED MEASUREMENTS AT THE HOLLOMAN TRACK, by G. Hughes and C. D. Leedham. Jan. 1962, 79p. incl. diagrs. tables, refs. (AFOSR/DRA-62-1) (AFOSR-2607) AD 276108 Unclassified

The quality of seeing at the Holloman track, being basic to all optical measurement methods to be described, has been measured. An analysis of possible optical systems for yaw, pitch, and roll measurement is reported. Based on this analysis, one optical measurement method is proposed for each attitude component. The analysis of space time data for test package vibrations is discussed in terms of the spacing of velocity measuring points along the track. A method is proposed to measure test package velocity rather than sled velocity relative to the track. (Contractor's abstract)

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

ON ESTIMATES OF LINEAR FUNCTIONS FOR TIME SERIES, by J. Abbott, P. Randolph, and J. Rosenblatt. July 1962, 37p. (AFOSR/DRA-62-12) (AFOSR-3531) AD 283037 Unclassified

The objective of this analysis is to establish a procedure for determining certain linear estimates of time series data. Since the immediate problem that led to this research was that of estimating velocity from position and time measurements, this analysis treats as a special case the problem of estimating velocity. Throughout, the procedures are developed within the framework of statistical decision theory.

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

SIMILITUDE CONSIDERATIONS IN SPACE

ENVIRONMENTAL SIMULATION, by T Y. Toong. Aug. 1962, 6p. (AFOSR DRA-62-16) (AFOSR-3534) AD 283353 Unclassified

Simulation of space environment has been examined on the basis of similitude considerations. Examples are given to indicate how subgravitational effects can be studied in an earth-bound laboratory. Conjectures are also made as to possible effects of subgravity on human locomotion and heart beat. It appears that much understanding of the subgravity effects on man can also be achieved by the use of similitude rules. The similitude considerations presented in this note can also be applied to the simulation of other more exotic space environmental conditions. (Contractor's abstract)

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

STUDY ON STRUCTURAL FEASIBILITY OF A FLYWHEEL ACCELERATOR, by R. F. Askew. May 1962, 32p. incl. diagrs. (AFOSR DRA-62-5) (In cooperation with Auburn U., Alabama) AD 276568 Unclassified

To determine the structural feasibility of a flywheel accelerator, this study was divided into 3 basic phases. First, the system was analyzed and configured to determine that satisfactory operation was present for all operational conditions. Second, a stress analysis was conducted to determine the influence of the centrifugal forces on the spokes and the rims of accelerator. The stress analysis considers the use of materials in the spokes and in the rim for the optimization of the weight distribution in the accelerator. Finally, an energy consideration was made for the determination of the power requirements. The equations derived in the third phase combined with the results of the second phase will enable the designer of a flywheel accelerator to meet all operational requirements. (Contractor's abstract)

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

STUDY OF SOFT RECOVERY FROM TWO-STAGE VEHICLES. PART II. VERTICAL DESCENT TRAJECTORIES INCLUDING AERODYNAMIC HEATING, by F. P. Ehni and W. F. Haldeman. May 1962, 141p. incl. diagrs. (AFOSR DRA-62-7) (In cooperation with Air Force Missile Development Center, Holloman AFB, Alamagordo, N. Mex.) AD 277911 Unclassified

Vertical descent trajectories are presented in graphical form for bodies entering the earth's atmosphere starting at an altitude of 320,000 ft with entry speeds varying from 35,000 to 7,500 fps. Two sets of trajectories were computed: one with fixed drag-area-to-weight ratios ranging from 10 to .001, and one set, where the drag-area-to-weight ratio is varying to achieve reentry with decelerations limited to 75, 30 and 15 g. The variation of the drag-to-weight ratio during descent was expressed in terms of a drag-area factor C. The computations were performed on an analog computer. Graphs are presented for velocity, deceleration, dynamic pressure, heating rate, total heat, temperatur , and for the limited deceleration case, the drag-area factor, plotted vs time and/or altitude. The physical equations are presented and their analog computer mechanization is discussed. (Contractor's abstract)

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

THE ATTACK AND DEFENSE OF TARGETS BY MISSILES, by W. R. McEwen. July 1962, 39p. incl. diagrs. (AFOSR/DRA-62-9) (In cooperation with Minnesota U., Duluth) AD 282136 Unclassified

Optimum methods are derived of attacking and defending targets with missiles under certain assumptions as to the number of missiles, antimissiles, and targets. Both probability and game theory are used in the derivations, and the results obtained by both methods are shown to be substantially the same. (Contractor's abstract)

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

ON THE NONLINEAR YAW MOTION OF A ROCKET SLED, by G. W. Braun and H. A. Melkus. July 1962, 43p. incl. illus. diagrs. table. (AFOSR/DRA-62-13) AD 287275 Unclassified

Some results are presented of an analog computer study concerned with the motion of a rocket sled configuration within a prescribed velocity profile. The motion of the sled was sidewise restricted by slippers running on rails. The dynamic properties of the sled were studied under idealized conditions; it was assumed that the moving body has only 2 degrees of freedom: namely, lateral displacement and yaw. The body's weathercock stability was varied from negative to positive values as it was assumed that this aerodynamic property influences the mode of motion. The effects of damping and that of play between slipper and rail were studied to obtain indications as to how these parameters affect the motion. (Contractor's abstract)

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

A PROPOSED IMPROVEMENT IN OPTIMIZATION TECHNIQUE FOR N-STAGED ROCKETS, by

H. P. Hotz and A. V. Houghton, III. July 1962, 42p. incl. diagrs. (AFOSR/DRA-62-14) (In cooperation with New Mexico U., Albuquerque) AD 287294 Unclassified

In the design of multistaged rockets, an essential feature is the optimization of the stages. This report is a comparison of the methods of Weisbord and Schurmann and the derivation of a new optimization procedure based on the energy rather than upon velocity as in earlier works. The numerical results of this method are compared with those of the earlier papers and it is shown that higher payload energies may be obtained for a given expenditure of fuel when the method of this report is used. Future refinements and improvements are suggested. (Contractor's abstract)

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Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

EFFECT OF PRESSURIZATION ON THE VIBRATION OF METAL BOXES, by S. H. Crandall. Aug. 1962, 15p. incl. diagrs. table. (AFOSR DRA-62-15) (In cooperation with Massachusetts Inst. of Tech., Cambridge) AD 284465 Unclassified

An analytical study is made of the vibrations of a sheet metal box including the effects of internal pressurization. These analytical results give partial clarification of experimental results previously obtained, but certain anomalies still remain. The changes in vibration conditions due to pressurization predicted by the analytical results are considerably smaller in magnitude than those obtained experimentally. (Contractor's abstract)

63

Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

MINIMUM FUEL TRANSITIONS, by J. Thomas. Nov. 1962, 45p. incl. diagrs. tables, refs. (AFOSR DRA-62-21) (In cooperation with New Mexico State U., University Park) AD 294359 Unclassified

The problem of finding the optimum method of transferring from one rocket orbit to another, where the criterion of optimality is that as little fuel as possible be expanded in the maneuver, is examined. Papers devoted to the aspects of this question were reviewed. In some cases, several minor calculations in the process of comparing and contrasting similar papers were carried out. Several numerical calculations are suggested and several questions are asked which, it is hoped, will be good starting points for future research on this program, as well as related questions of a more general mathematical character. (Contractor's abstract)

64

Air Force Office of Scientific Research. Directorate of Research Analyses, Holloman AFB, Alamagordo, N. Mex.

STELLAR SIMULATOR, by W. F. Chambers. Dec. 1962, 13p. incl. illus. diagrs. table. (AFOSR DRA-62-22) (In cooperation with Duke U., Durham, N. C.) AD 292649 Unclassified

An analysis is presented which shows the feasibility of a system that will reproduce the blackbody radiation spectrum of any star by forming the spectrum of a source, choosing the appropriate portions of the formed spectrum, and recombining the chosen portions into white light.

65

Air Technology Corp., Cambridge, Mass.

THE OPTICAL EFFECT OF A DETACHED SHOCK WAVE IN FRONT OF A ROUNDED NOSE WINDOW, by R. E. Clapp. May 1962 [47]p. incl. diagrs. tables. (AFOSR/DRA-62-8) (AF 29(600)3070) AD 284588 Unclassified

Optical ray-tracing techniques, using air density distributions provided by NASA, have been used to compute the optical distortion introduced by a detached shock wave. A detailed study for the case of a spherical nose window at Mach 2 showed that the central portion of the shock layer was optically equivalent to a thin lens, slightly diverging, located well back of the nose surface. The optical deflection for a ray near the axis was computed as a function of Mach number for several nose shapes (sphere, paraboloid, and oblate ellipsoid). The results showed that over the window aperture the deflection could be kept within a few sec of angle by a suitable window design. (Contractor's abstract)

66

Alabama U. [Dept. of Physics] University.

SPIN-LATTICE RELAXATION TIMES OF BROMINE PURE QUADRUPOLE RESONANCES AT LOW TEMPERATURES (Abstract), by R. F. Tipsword and W. G. Moulton. [1962] [1]p. [AF AFOSR-61-43] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 574, Nov. 23, 1962.

The spin-lattice relaxation times for Br^{81} and Br^{79} in p-dibromobenzene and sodium bromate have been measured at 4.2°K. The sample was saturated with a large r.f. power from a regenerative spectrometer and the growth of the signal amplitude with small power incident on the sample was observed. It was found possible to reduce the power well below the saturation level and thus obtain reproducible data. The signal amplitude increases

exponentially with time, as would be expected. By a least-squares fitting, T_1 = 46 ± 2 min for Br^{79} and 75 ± 3 min for Br^{81} in p-dibromobenzene. The data for $NaBrO_3$ cannot be fitted by a single exponential, but require 2 different relaxation times. This phenomenon is tentatively ascribed to the fact that impurity relaxation and quadrupolar relaxation mechanisms may be of the same order in $NaBrO_3$ at 4.2°K. Preliminary analysis yields relaxation times of 120 and 80 min for Br^{81} and 155 and 85 min for Br^{79}. Relaxation mechanisms, the temperature dependence, and measurements on individual Zeeman components are discussed.

67

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

AN ANOMALOUS DISSIPATION FACTOR MAXIMUM IN SAPPHIRE, by N. M. Tallan and D. P. Detwiler. [1962] [7]p. incl. diagrs. refs. [AF 49(638)87] AD 416016 Unclassified

Published in Jour. Appl. Phys., v. 34: 1650-1656, June 1963.

The temperature and frequency dependencies of the dielectric properties of sapphire were determined by guarded measurements within the ranges −160° to 400°C and 10^2 to 10^4 cps. A broad dissipation factor maximum, exhibiting apparently anomalous behavior, was observed. Although the frequency at which the maximum occurred was exponentially temperature-dependent, activation energy values calculated on the basis of a dipolar relaxation model varied reversibly between ..2 and 0.5 ev as a function of vacuum heat treatment at 400°C and of exposure to dry hydrogen, dry oxygen, or moist air. The dissipation factor behavior which would result from 2 alternative mechanisms, interfacial polarization and resonance, is discussed briefly on the basis of the possible existence of variable conductivity surface layers and the possible presence of hydrogen in the vicinity of dislocations.

68

[Allied Research Associates, Inc., Boston, Mass.]

HEAT-BALANCE-INTEGRAL METHOD FOR PULSE-LIKE HEAT INPUTS, by T. R. Goodman and N. Ullah. Feb. 1962, 33p. incl diagrs. (AFOSR-2261) (AF 49-(638)839) AD 273118 Unclassified

The method of the heat-balance integral is extended to handle heat condition problems with arbitrary pulse type heat inputs. A general solution is given using quadratic and cubic temperature profiles. The results for triangular and parabolic heat pulses are shown graphically and compared with the exact ones. The temperature-dependent heat flux problem is also briefly discussed. (Contractor's abstract)

69

American Inst. for Research, San Mateo, Calif.

RETENTION OF MATERIAL PRESENTED BY AUTOINSTRUCTIONAL PROGRAMS WHICH VANISH AND WHICH DO NOT VANISH VERBAL CUES, by D. Angell and A. A. Lumsdaine. Aug. 1962 [14]p. incl. tables, refs. (Research rept. no. AIR-C14-8/62-TR) (AFOSR-3540) (AF 49(638)681) AD 285324 Unclassified

Subjects' performance on tests of immediate and delayed retention was measured following instruction by 2 versions of an autoinstructional program: one version employed vanishing (the successive reduction of stimulus support) and the other did not. Classes of 4th-, 5th-, and 6th-grade students served as Ss. No significant difference between the performance of Ss who had used the vanishing and the nonvanishing versions of the program was found on the immediate test. On the test taken 2 weeks after initial training, however, the Ss who had used the vanishing version of the program were found to have retained significantly more than Ss who had used the nonvanishing version. The results are interpreted in terms of the effects of context variables upon retention. (Contractor's abstract)

70

American Inst. for Research, San Mateo, Calif.

RESPONSE GUIDANCE, RESPONSE-TERM SIMILARITY, AND TEST TYPE IN THE LEARNING AND RETENTION OF WORD PAIRS, by D. Angell and D. F. Terry. Sept. 1962 [27]p. incl. diagrs. tables, refs. (Research rept. no. AIR-C14-9/62-TR) (AFOSR-3673) (AF 49(638)681) AD 289296 Unclassified

It was hypothesized that: (1) high cueing level would be more effective than low cueing, (2) the influence of cueing would be greater when easily confusable incorrect alternatives were present during training than when less easily confusable alternatives were present, and (3) training with easily confusable alternative response terms would be more effective than training with less confusable alternatives when the criterion behavior required discriminating between the correct response term and the easily confusable alternatives. Both immediate and delayed test results bore out the first hypothesis. The second hypothesis was confirmed by comparisons made on the results of the test coming at the end of the acquisition session. The third hypothesis was confirmed for the high and medium cueing levels but not for the low cueing level. It was also found that Ss who took recall tests during training performed better on the delayed retention tests than Ss who took recognition tests during training. It was concluded that prompting is more effective than anticipating in discrimination training, and that when high probability incorrect alternatives are presented, eliciting only the correct response is efficient training when the criterion behavior involves discriminating among the high probability alternatives. (Contractor's abstract, in part)

71

American Inst. for Research, San Mateo, Calif.

RESEARCH ON CUEING FACTORS RELATED TO PROGRAMMED INSTRUCTION, by D. Angell and A. A. Lumsdaine. [Final rept.] Sept. 1962. 17p. incl. refs. (Research rept no. AIR-C14-9-62-TR2) (AFOSR-3704) (AF 49(638)081 Unclassified

The experimental work of a project which investigated a number of aspects of cueing theory and practice related to automated instruction is recapitulated. The main portion of the summary is organized into 4 sections: Survey of cueing methods, Intertrial variations in cueing, Intratrial variations in cueing, and Response guidance and cueing by feedback. The report contains a list of the reports, papers, and other direct products of the research, giving complete bibliographic references and publication sources. (Contractor's abstract)

72

American Mathematical Soc., Providence, R. I.

MATHEMATICS ADVISORY AND EVALUATION SERVICES. Jan. 1960-Dec. 1962. (AF 49(638)204) Unclassified

This contract provides for an evaluation service to the Mathematics and Applied Mathematics Divisions of the Mathematical Sciences Directorate. Upon request, distinguished mathematicians review and evaluate proposed new directions for mathematical research, new mathematical ideas, and the importance of contemporary mathematical results. The contract also provides for an AFOSR Mathematics Advisory Committee which weighs the general direction of mathematical research, in particular of research supported by the Mathematics and Applied Mathematics Divisions of the Mathematical Sciences Directorate. Present membership consists of Prof. M. H. Stone, Chairman, and Profs. S. Bochner, S. Boldstein, H. Morse, J. L. Walsh and R. L. Wilder.

73

American Soc. of Mechanical Engineers, New York.

APPLIED MECHANICS REVIEWS: WADEX WORD AND AUTHOR INDEX, VOLUME 15, 1962, by E. A. Ripperger, B. A. Wooster and others. 1963, 576p. (AFOSR-J1551) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-63-33] and Office of Naval Research) Unclassified

WADEX, a computer-made index, is an experimental information retrieval project of Applied Mechanics Reviews. It is a modified form of the previous Key Word Out of Context (KWOC) indexes, and has been given the name WADEX where the letters stand for Word & Authors inDEX. This index incorporates many excellent features of previously published machine-made indexes and wherever it differs from others, the alterations have been made with specific objectives in mind. Each entry is composed of 3 parts: (1) descriptor, (2) reference numbers, and (3) bibliographical entry. The descriptor is a work or an author's name. The reference number contains the year, month, and item number. Bibliographical entry contains the author(s) name and the full title of the publication. Since WADEX, unlike most machine-made indexes, is an annual publication, it is most suitable to retrospective search, whereas the monthly indexes are more suitable for current awareness information.

74

American Vacuum Soc., Inc., Boston, Mass.

1961 TRANSACTIONS OF THE EIGHTH NATIONAL VACUUM SYMPOSIUM COMBINED WITH THE SECOND INTERNATIONAL CONGRESS ON VACUUM SCIENCE AND TECHNOLOGY, VOLUMES 1 AND 2, Washington, D. C., Oct. 16-19, 1961, ed. by L. E. Preuss. New York, Pergamon Press, 1962, 2v. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [MIPR 62-3], Army Research Office, and Office of Naval Research) Unclassified

Approximately 1800 scientists registered for the sessions of the combined vacuum symposium and international congress. Adding to this number a large group who registered separately for a technical exhibit, there was a total attendance of well over 2,000 technical workers, representing approximately 20 nations. Two hundred and one technical papers appear in these transactions. Among the topics covered in the 22 sessions are: limitations in the attainment of ultra-high vacuum, fore pumps, components, vaporizing sources and freeze drying, adsorption, vacuum metallurgy, space simulation, cryopumping, leaks and gas flow, gauges, thin films, mass spectrometers, diffusion pumps, and getter-ion pumps.

75

Analytic Services, Inc., Bailey's Crossroads, Va.

USEFULNESS OF SOLAR OUTBURST PREDICTION, by B. W. Shore. [1962] [3]p. incl. diagrs. tables. (AF 49(638)491) Unclassified

Published in ARS Jour., v. 32: 1737-1739, Nov. 1962.

Because outbursts of charged particles from the sun constitute a major hazard for space flight, prediction of these events would be useful. An indication of the degree of usefulness may be gained by contrasting the "safe" flights possible under accurate prediction of each event with those possible under no prediction ability. This note presents such a contrast, based on observed solar activity from 1954 through 1961. (Contractor's abstract)

76

Arizona State U. [Dept. of Mathematics] Tempe.

PARTIALLY BOUNDED J-FRACTIONS, by L. G. Riggs and W. T. Scott. [1961] [11]p. (AFOSR-64-0205) (AF AFOSR-62-310) AD 432567 Unclassified

Also published in Trans. Amer. Math. Soc., v. 109: 45-55, Oct. 1963.

For J-fractions $\cfrac{1}{z+b_1-}\ \cfrac{a_1^2}{z+b_2-}\ \cfrac{a_2^2}{z+b_3-}\ \ldots$ that are

bounded, Wall developed a convergence theory. In this paper analogues of Wall's results have been obtained for a wider class of J-fractions, namely, partially bounded J-fractions, whose coefficients are not necessarily bounded. (Math. Rev. abstract)

77

Arizona State U. [Dept. of Physics] Tempe.

ELECTRICAL PROPERTIES OF OXIDES OF SOME LANTHANIDE RARE EARTH ELEMENTS, by C. J. Kevane. Final rept. Feb. 28, 1962, 35p. incl. illus. diagrs. refs. (AFOSR-2230) (AF 49(638)789) AD 274510 Unclassified

Electrical conduction was studied in ceramic CeO_2 and Pr_2O_3 from room temperature to near 600°C. Measurements were primarily 2-contact direct current type although some 2-contact ac measurements were made on CeO_2. Some electrical conductivity effects of departures from stoichiometry were studied in Pr_2O_3 and CeO_2 using a quartz-beam microbalance. At temperatures between 400° and 600°C, the current which flows between Pt electrodes through CeO_2 at constant applied potential showed a decreasing transient. Above 600°C, the low-bias transients became increasing transients and at intermediate biases the transients disappeared. The ac resistance and capacitance of CeO_2 ceramic pellet with Pt electrodes were strongly frequency dependent. The ac sample resistance decreased with frequency as did the capacitance. At low frequency the capacitance became very large and if this capacitance were considered to be a bulk material effect it would correspond to a very large dielectric coefficient at frequencies near 100°C. Sintered ceramic pellets of CeO_2 containing 1% CaO appeared to exhibit ionic conduction and electrolysis under the action of an applied dc potential. (Contractor's abstract)

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Arizona State U. Dept. of Physics, Tempe.

ELECTROLYTIC CONDUCTION IN CALCIUM-DOPED SOLID CERIUM OXIDE, by C. J. Kevane, E. L. Holverson, and R. D. Watson. [1962] [5]p. incl. illus. diagrs. refs. (AFOSR-J1099) [AF 49(638)789] AD 422261 Unclassified

Also published in Jour. Appl. Phys., v. 34: 2083-2087, July 1963.

At 460°C the passage of direct current through ceramic pellets of cerium dioxide containing one weight percent calcium oxide caused distinct volume discolorations to appear. The current at constant applied bias increased gradually from its initial value during the formation of the discolored regions, finally reaching a new, stable, higher level if sufficient time elapsed. In the latter case, both anode and cathode surfaces were discolored and the discoloration extended completely through the body of a pellet. When insufficient time was allowed for the current to reach a new, stable level, only the cathode surface was discolored and the discoloration extended only part way through the material. The discolorations could always be removed by heating the pellets for 1 hr in air at 600°C and the entire process could be repeated many times. These effects are interpreted to indicate that a significant fraction of the current in this material at this temperature is carried by oxygen ions which move the anode where they are plated-out leaving reduced, discolored material. (Contractor's abstract)

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Arizona State U. [Dept. of Physics] Tempe.

ELECTROLYTIC CONDUCTION IN SOLID CERIUM OXIDE (Abstract), by C. J. Kevane, E. L. Holverson, and R. D. Watson. [1962] [1]p. [AF 49(638)789] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 497, Aug. 27, 1962.

Results of electrical measurements carried out between room temperature and 600°C are tentatively interpreted to indicate significant ionic conduction in solid sintered cerium dioxide. The direct current flowing through sample pellets between platinum-foil electrodes was studied as a function of constant applied voltage, temperature and time. Material studied was pure (99.9 + %) or doped with small amounts of calcium oxide. The pure-oxide samples showed pronounced decreasing transients following application of the voltage. The magnitude of this effect decreased as the temperature increased to 600°C, and at 730°C it had virtually disappeared. The addition of calcium oxide results in great enhancement of conduction. Also, the passage of 10^{-5} to 10^{-3} C charge at 450°C through the calcium-doped samples is accompanied by a decrease of sample resistance and the appearance of discolored regions between the electrodes. The discolored region first appears at the cathode and grows through the sample to the anode. These general effects are taken to be evidence of polarization due to oxygen-ion migration with blocking at the anode and of reduction due to plating-out of oxygen.

80

Arizona U., Tucson.

DEFINING THE QUERY SPECTRUM— THE BASIS FOR DEVELOPING AND EVALUATING INFORMATION-RETRIEVAL METHODS, by J. W. Perry. [1962] [8]p. incl. diagrs. (AFOSR-64-0563) (AF AFOSR-61-79) AD 434293 Unclassified

Also published in I. E. E. E. Trans. on Eng. Writing and Speech, v. EWS-6: 20-27, Feb. 1963.

In designing a retrieval system for technical information, consideration of what practical benefits will result must be weighed against the costs of its operation. Thus, definitions of what queries to the system and what responses to them will be most useful in a given research, industrial, or management situation are of great importance. In such analysis, there are important factors (such as the actual relation between technological progress and recorded information) that can be defined qualitatively, but that defy precise study and quantitative measurement. Corresponding factors in Patent Office operations offer the possibility of operational study, since queries that the Patent examiner must answer have a similarity to the queries of importance in planning and conducting industrial research and development. (Contractor's abstract)

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Arizona U., Tucson.

COMMUNICATION SYSTEMS. DESIGN AND THEORY, by J. W. Perry. [1962] [34]p. incl. diagrs. refs. (AFOSR-64-0564) (AF AFOSR-61-79) AD 434413 Unclassified

Also published in Proc. Fifth Annual Inst. in Technical and Industrial Communications, Colorado State U., Fort Collins (July 1962), p. 110-114.

The scientific and technological advances of recent decades have been paralleled by continuing increases in the amount and complexity of scientific and technical information. Its effective use is critically important to the national welfare, especially to maintaining and expanding industrial and agricultural productivity, to developing means for exploring outer space, and to attaining adjustments of international tensions. At the end of World War II, it was apparent, at least to the more farsighted, that a severe bottleneck situation had developed in methods for identifying pertinent documents in large files and libraries. Efforts to break this bottleneck during the past 15 yr have made use of various automatic and semi-automatic devices. Parameters are defined in order to specify simularities and differences among various document selection methods. These results, expressed in flowchart form, provide a preliminary mathematical model whose detailed development is outside the scope of this paper. The immediate purpose of this mathematical model is to guide the design of documentation selection systems as well as their administration and management. To serve this purpose, both requirements to be met as well as circumstances of operation must be analyzed in terms of well-defined parameters. The results presented point toward a strategy for the development of a comprehensive theory of communication for understanding. (Contractor's abstract)

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Arizona U. Dept. of Physics, Tucson.

TECHNIQUES FOR QUENCHING POINT DEFECTS IN METAL WIRES, by R. M. Emrick. [1962] [22]p incl. diagrs. tables. (AFOSR-2581) (AF 49(638)790) AD 289122 Unclassified

The study of point lattice imperfections is greatly enhanced if the formation and motion of the defects can be observed separately. The quench technique allows the study of point defect formation and motion under a wide variety of physical environments, limited mainly by the ingenuity of the experimenter. The purpose of this paper is to outline some of the techniques which have been developed through the years. The techniques, for the most part have not been developed by the author.

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Arizona U. [Dept. of Physics] Tucson.

SOLID STATE REACTIONS UNDER HIGH PRESSURE, by C. T. Tomizuka. [1962] [4]p. incl. illus. refs. [AF 49(638)790] Unclassified

Published in Kagaku (Science), v. 32: 539-542, 1962.

Work on solid state reactions under high pressure is reviewed. A list of 12 references is included.

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Arizona U Dept. of Physics, Tucson.

EFFECT OF HYDROSTATIC PRESSURE ON THE RATE OF ATOMIC MOVEMENT IN NOBLE METALS, by C. T. Tomizuka. [1962] [2]p. (AFOSR-J565) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-105 and Atomic Energy Commission) AD 412680 Unclassified

Presented at Internat'l. Conf. on Crystal Lattice Defects, Kyoto (Japan), Sept. 7-12, 1962.

Also published in Jour. Phys Soc. Japan, v. 18, Suppl. II: 228-229, Mar. 1963

The measurement of self-diffusion rates in single crystals of silver at high pressures up to 8KB was carried out in a pressurized argon system. The activation volume thus obtained was 90% of the atomic volume. This value represents the sum of the volume of a vacancy at rest and the volume expansion introduced by the migration of a vacancy into a saddle point configuration. This latter quantity was estimated by Emrick in gold by measuring the pressure effect on the annealing rate of the quenched-in vacancies in gold. The value of 15% of the atomic volume was obtained by this method. If

it can be assumed that a similar value holds for silver, then the static volume of a vacancy in silver is 75% of the atomic volume. It is necessary to perform the quenching experiment under pressure in order to obtain the static vacancy volume directly. This can be accomplished if a sufficiently large quenching rate can be achieved at high pressure. Preliminary experiments indicate that the quenching rate of 10^4 deg. sec is possible at the pressure range of 2.5KB to 9KB. In order to increase the quenching rate and remove some difficulties associated with a dc heating, a pulse heating method is being tested.

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Arizona U. Dept. of Physics, Tucson.

ANOMALOUS DIFFUSION RATE FOR SMALL PENETRATION DISTANCE IN COPPER, by D. L. Styris and C. T. Tomizuka. [1962] [1]p. incl. diagr. (AFOSR-J567) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-105 and Atomic Energy Commission) AD 407389 Unclassified

Also published in Jour. Appl. Phys., v. 34: 1001-1002, Apr. 1963.

It is now possible to determine the tracer diffusion coefficient for penetration distances less than one micron by employing a chemical sectioning technique which will be explained in more detail in a future publication. During the course of testing the lower limit of diffusion coefficients which can be measured by this technique, an anomalously small diffusion coefficient was measured for the diffusion of radioactive Zn^{65} in a single crystal of Cu.

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[Arkansas U. Dept. of Chemistry, Fayetteville]

OXIDATION OF METALS IN MOLTEN SALTS. SILVER IN SODIUM CHLORIDE, by K. H. Stern. [1962] [7]p. incl. diagrs. table, refs. (AFOSR-3794) (AF 49(638)-653) Unclassified

Presented at 137th Nat'l. meeting of the Amer. Chem. Soc., Cleveland, Ohio, Apr. 1960.

Also published in Jour. Phys. Chem., v. 66: 1311-1317, July 1962.

The rate of oxidation of silver in sodium chloride near 900 has been determined under a variety of conditions. When the rate of O_2 transport to the Ag-NaCl interface is low, the reaction is zero order: when it is high, the rate varies as $\sqrt{\text{time}}$, indicating a rate controlled by the diffusion of products away from the reaction site. Under all conditions the $Ag^+ O^=$ ratio is greater than can be accounted for by the formatio. of Ag_2O. The results can be accounted for by hypothesizing 2 simultaneous reactions, (a) $2Ag + 1\ 2O_2 = 2Ag^+ + O^=$, (b) $Ag^0 + Na^+ - Ag^+ + Na^0$, which produce ionic silver, the relative contributions to total Ag^+ of the reactions depending on conditions. The equilibrium constant for (a) is 8.3×10^{-7} on the mol fraction scale.

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Arkansas U. Dept. of Physics, Fayetteville.

A SPECTROSCOPIC INVESTIGATION OF NUCLEAR PROPERTIES, by R. H. Hughes. Final rept. June 30, 1962 [10]p. incl. diagr. (AFOSR-4044) (AF 49(638)547) Unclassified

Research is reported on isotope shift in the spectra of molybdenum, ruthenium, palladium, and tellerium. An atomic beam light source was constructed and used to study the fine structure separation in the $2\ ^2S - 3\ ^2P$ line of lithium (λ 3233A). A pressure scan Fabry-Perot interferometer was constructed and used in conjunction with a photon counter. Three reprints of published work resulting from the research are appended. (See item nos. 64, 65 in Vol. IV, and no. 59, Vol. V.)

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Arkansas U. Dept. of Physics, Fayetteville.

POLARIZATION OF OPTICAL RADIATION INDUCED BY ELECTRON IMPACT ON HELIUM, by R. H. Hughes, R. B. Kay, and L. D. Weaver. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-J297) (AF AFOSR-62-159) AD 408041 Unclassified

Also published in Phys. Rev., v. 129: 1630-1637, Feb. 15, 1963.

An investigation of the polarization of the atomic line radiation induced by electron impact on helium has been undertaken. Experimental data have been obtained on the polarization of several lines as a function of both electron energy and pressure. Secondary excitation processes, such as collision of the second kind and radiative transfer (cascade), are found to play an important role in the polarization. Expressions are derived for the analysis of the pressure effects on the polarization. Gas-kinetic collision cross sections involving atoms in excited states have been determined by observing the depolarization as the gas pressure increases.

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Athens U. [Dept. of Physics] (Greece).

INVESTIGATION OF HEAT VIBRATIONS IN SOLIDS BY USING X-RAYS, by A. Theodossiou. Annual rept. no. 4, Feb. 1, 1960-Jan. 31, 1961 [13]p. incl. diagrs. tables. (AFOSR-840) (AF 61(514)1248) AD 622820 Unclassified

A suitable furnace was constructed enabling the annealing of samples in an inert gas stream up to 700°C. A suitable vacuum chamber was constructed to extend the measurements on the Philips goniometer at low temperature. Measurements were carried out on silver

and gold at low temperature, on lead at high temperature and on platinuum at high and low temperature. Experiments were also made on thallium but without success. Results are presented in tabular and graphic form.

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Atlantic Research Corp., Alexandria, Va.

LINE SHAPES IN THE SPECTRA EMITTED BY A HIGH-DENSITY CESIUM PLASMA (Abstract), by L. W. Fagg. [1962] [1]p. [AF 49(638)651] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 274-275, Apr. 23, 1962.

The spectra emitted from the high-density cesium plasmas ($\sim 10^{16}$ cm. cc) created by thermal excitation in the burning of $CsClO_4$:Al and $CsNO_3$:Al mixtures at atmospheric pressure have been studied with a spectrograph of 5A mm dispersion. The cesium transitions $ns_{1\ 2} - 6p_{1\ 2}$, $6p_{3\ 2}$ and $np_{1\ 2}$, $np_{3\ 2} - 6s_{1\ 2}$ exhibit very asymmetric line shapes; whereas, the $nd_{3\ 2}$, $5\ 2 - 6p_{1\ 2}$, $6p_{3\ 2}$ transitions are relatively symmetric. Comparison of the experimental shapes with those predicted by the theories of Griem et al and of Ecker are made along with a discussion of the discrepancies. Values of the electron density and temperature resulting from the spectrographic observations also are presented.

91

Atlantic Research Corp., Alexandria, Va.

STUDY OF ELECTRON GENERATION BY SOLID PROPELLANT TECHNIQUE, by R. Friedman, L. W. Fagg and others. Sept. 21, 1962. 22p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Cambridge Research Lab.; and Air Force Office of Scientific Research under AF 49(638)651) AD 605175 Unclassified

Presented at ARS Conf. on Ions in Flames and Rocket Exhausts, Palm Springs, Calif., Oct. 10-12, 1962.

Also published in Prog. in Astronaut. and Aeronaut., v. 12: 379-393, 1963.

Electron generators functioning by combustion of a cesium nitrate-aluminum pressed charge have been developed and test-fired in an altitude chamber. Thermodynamic analysis of the combustion and nozzle-expansion process shows that about 10^{20} power electrons are discharged per gram of charge, the gaseous product containing about 2 mol-% electrons. Spectroscopic measurements of the exhaust plume at 40 mm Hg abs confirm electron concentrations of this magnitude via Stark-broadening of cesium emission lines. Details of generator operation are given, and alternate chemical systems for electron generation are discussed.

92

Atlantic Research Corp , Alexandria, Va.

SOLID PROPELLANT COMBUSTION MECHANISM (Abstract), by R. Friedman and J B. Levy. [1961] [1]p. [AF 49(638)813] Unclassified

Presented at Third AFOSR Contractors' meeting; on Combustion of Solid Propellants, Utah U., Salt Lake City, Jan. 30-31, 1961. (AFOSR-986)

Mechanism studies of pure ammonium perchlorate (AP) deflagration are reported. In view of the strong effect of pressure on AP flame propagation, gaseous kinetics is believed to play an important role. Perchloric acid vapor is probably a critical species, so its reactivity is being studied. Nonflow experiments have been conducted in glass and quartz vessels at 200-350°C, decomposition being followed by variation of optical absorption with time. At least the first half of the decomposition follows first-order kinetics with half-lives ranging from minutes to hours. The reaction is accelerated by light, inhibited by water vapor (a product), unaffected by inert gas addition or initial pressure of reactant over the range studies, and markedly accelerated by the Pyrex container surface in the 200-250°C temperature range (but not above 300) unless the surface is specially prepared before each test. In another series of experiments, the effect of sample diameter on lower pressure limit of deflagration has been studied. Increasing diameter from 4 mm to 25 mm reduces the lower limit only slightly, from 330 psi to 290 psi. This suggests a radiative rather than a conductive or convective heat loss mechanism. Another technique being explored involves combustion studies of pressed AP in which a tiny hole has been drilled and filled with organic polymer, the hole axis being initially normal to the flame front. By interrupting the burning, the angle at the AP-polymer interface can be observed. Under certain conditions a conical AP surface is produced with the polymer at the vertex, the sine of the cone half-angle corresponding to the ratio of flame propagation rates without and with the polymer-filled hole present. Effects of incident radiation, pressure, and hole size on this interaction are being investigated

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

HIGH-SPEED INFRARED BOLOMETER, by M. Camac and R. [M.] Feinberg. Mar. 1962 [73]p. incl. illus. diagrs. tables, refs. (Research rept. no. 120) (AFOSR-1564) (Sponsored jointly by Air Force Cambridge Research Lab.; and Air Force Office of Scientific Research under AF 49(638)61) AD 275131 Unclassified

Also published in Rev Scient. Instr., v. 33 964-972, Sept. 1962.

A new type of heat transfer gauge that operates in the presence of highly ionized plasmas and in strong electric and magnetic fields has been developed. The principle of its operation is to use a thin opaque surface as the heat transfer element. Aerodynamic and

radiative heating is applied to 1 side of this layer, while measurements are made of the change of the infrared emission from the other side. This system is essentially a boiometer. Components are described of the heat transfer system and the methods are given for calibrating the gauge for heating pulses of long and short duration The response of the system to a variety of heat pulses was calculated. Measurements are presented of the aerodynamic heat transfer from shock heated air, and the response time of the gauge to short heat pulses is evaluated. This infrared heat transfer system worked successfully in the presence of strong electromagnetic fields. side wall heat transfer measurements were made on the Magnetic Annular Shock Tube where the temperature of the hydrogen plasma was in excess of 100,000 °K. (Contractor's abstract)

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

CURRENT DISTRIBUTION AND FLOW MODEL FOR LARGE RADIUS-RATIO MAST, by J. C. Keck, F. [J.] Fishman, and H. [E.] Petschek. Jan. 1962, 12p. incl. illus. diagrs. (Research rept. no. 117) (AFOSR-2194) (AF 49(638)659) AD 274094 Unclassified

The non-uniform flow in a magnetic annular shock tube (MAST, with an annular spacing larger than the radius of the inner cylinder is described. Experiments were conducted in a MAST with inner and outer radii of 1 and 3 in. The speed of the disturbance produced in the tube was found to depend upon the polarity of the discharge. The distribution of current in the tube was determined with probe coils, it too, depended on polarity. With the inner electrode positive the current was largely confined to a thin sheet that was strongly canted with respect to the walls, the inner edge leading. A thicker current sheet that was nearly normal to the tube walls was observed in the inverse polarity condition. A model is proposed to explain the operation with positive center electrode. The shape of the forward part of the current sheet is calculated by balancing the magnetic pressure behind the sheet with the gas pressure in front; the Newtonian approximation is used for the gas pressure. The resulting shape, which is approximately parabolic, agrees roughly with experiment It is proposed that the dependence of the flow on polarity is associated with electron emission problems, and that in positive operation ions carry a substantial part of the current. (Contractor's abstract)

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

ELECTROSTATIC ACCELERATION OF NEUTRAL PLASMAS—MOMENTUM TRANSFER THROUGH MAGNETIC FIELDS, by G. S. Janes, J. Dotson, and T. Wilson. [1962] [24]p. incl. illus. diagrs. refs. (AFOSR-3887) (AF 49(638)659) AD 290073: AD 405492 Unclassified

Also published in Proc. Third Symposium on Advanced Propulsion Concepts, Cincinnati, Ohio (Oct. 2-4, 1962), New York, Gordon and Breach Science Publishers, v. 1: 153-176, 1963.

Electrostatic plasma accelerators which avoid the space charge limitations of conventional ion rockets are described. Additional advantages for these devices include moderate requirements on magnetic field strength, and on power level. Both classical and anomalous (Bohm type) electron diffusion models are considered. Experiments are described which substantiate the existence of the described mechanism for momentum transfer to neutral plasmas. The experiments are in approximate agreement with the anomalous (Bohm type) diffusion model and are in clear disagreement with the classical diffusion model. The engineering significance of this result and possible approaches for dealing with it are considered.

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

PLASMA FLOW IN A MAGNETIC ANNULAR ARC NOZZLE, by R. M. Patrick and W. E. Powers. [1962] [22]p. incl. illus. diagrs. table. (AFOSR-3901) (AF 49(638)659) AD 290082 Unclassified

Also published in Proc. Third Symposium on Advanced Propulsion Concepts, Cincinnati, Ohio (Oct. 2-4, 1962), New York, Gordon and Breach Science Publishers, v. 1: 115-136, 1963.

A report is made of an experimental investigation of plasma flow in a magnetic annular arc, emphasizing the flow in the expansion region, in order to study the characteristics of plasma accelerators. The nozzle configurations used are described. It is shown that a stable arc can be made in a coaxial configuration with an axial field which produces a steady, azimuthally uniform plasma, and that plasma flow properties are different in a wide angle nozzle, where the plasma swirl does not dominate the flow. The device used can produce an average exhaust velocity corresponding to a specific impulse of nearly 600 sec, with an overall thrust efficiency of 25%.

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

CURRENT DISTRIBUTION IN A MAGNETIC ANNULAR SHOCK TUBE, by J. C. Keck. [1962] [3]p. incl. illus. diagrs. (AFOSR-65-0566; (AF 49(538)659) AD 614212 Unclassified

Also published in Phys. Fluids, v. 5: 630-632, May 1962.

Very little is known about the exact mechanism by which the magnetic field accelerates the gas in a shock tube. It is the purpose of this note to give a preliminary report of some studies of the shock shape and current distribution in a magnetic annular shock tube which may assist in achieving an understanding of the above problem, as well as others involving the dynamic interaction of a gas and a magnetic field. The magnetic

field in the tube was mapped out point by point by inserting the probes to axial positions opposite the uv speed detectors and scanning radially in 1-cm steps across the 5-cm gap. It is shown that the current pattern in the shock tube depends on the polarity of operation. For a positive (outward) radial current, the thickness of the current sheet is ~2 cm, while for a negative (inward) current, it is more than twice as thick. Also, the shape of the current sheet changes when the polarity of operation is reversed. For positive operation, the current sheet is severely canted with the inner edge leading the outer edge by 1.5 μsec in time or 8 cm in space. For negative operation the sheet, although not as well defined, is more or less perpendicular to the walls.

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

FLOW MODEL FOR LARGE RADIUS-RATIO MAGNETIC ANNULAR SHOCK-TUBE OPERATION, by F. J. Fishman and H. [E.] Petschek. [1962] [2]p. incl. diagrs. (AFOSR-65-0694) (AF 49(638)659) Unclassified

Also published in Phys. Fluids, v. 5: 632-633, May 1962.

In this note a model is proposed that explains some features of the behavior of magnetic annular shock tubes of large radius ratio as reported by Keck. Topics discussed are the shape of the current sheet when the center electrode is positive, the speed of this current sheet, and the difference between positive and negative operation.

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

ANOMALOUS ELECTRON DIFFUSION IN EM-REGION PLASMA-ACCELERATION EXPERIMENTS (Abstract), by G. S. Janes and T. Wilson. [1962] [1]p. [AF 49-(638)659] Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 149, Feb. 28, 1963.

In the EM region, the mean free path and ion-gyro radius are larger than the apparatus size, while the electron-gyro radius and the Debye shielding distance are still relatively small. Consider cylindrical and annular geometries with axial electric fields and radial magnetic fields. Ions will accelerate axially in the electric field, but the axial drift of electrons is strongly inhibited by magnetic fields. Circumferential electron drifts constitute a current that interacts with the magnetic field. Experiments substantiate this plasma-acceleration mechanism. The magnitude and magnetic field dependence of the observed rates of axial electron drift are well described by the anomalous 1 B (Bohm-type) diffusion model and disagree with the classical 1 B^2 diffusion model. Analysis indicates the fractional energy loss to electron heating will be comparable with the anomalous diffusion constant α times the ratio of the ion gyro radius to the total acceleration length.

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

MAGNETIC ANNULAR ARC, by W. E. Powers and R. M. Patrick, May 1962, 33p. incl. illus. diagrs. table. (Research rept. no. 129) (AF 49(638)659) AD 409886 Unclassified

Also published in Phys. Fluids, v. 5: 1196-1206, Oct. 1962.

The performance characteristics of an annular-arc configuration under the influence of a magnetic field have been experimentally analyzed, particularly with respect to the effects of tensor conductivity and j x B body forces. In this device the plasma conditions are such that the electrical conductivity is insufficient to prevent the diffusion of the plasma through the magnetic field, i.e., the magnetic Reynolds number was small. Experiments were conducted with this device using helium and argon at power levels up to 50 kw, magnetic field strengths to 10,000 gauss, and particle densities of the order of 10^{16} cm^3 to $10^{17}/cm^3$. The electron gyroradius was smaller than the electron mean free path, i.e., $\omega_e\tau_e > 1$, where ω_e is the gyrofrequency, and τ_e is the time between collisions for electrons. The impedance of the arc in helium was found to vary linearly with $\omega_e\tau_e$. The existence of a circulating azimuthal Hall current was also demonstrated. A yaw probe was employed to measure the angle of the flow due to the j x B Lorentz forces. A good agreement was found between the measured rotation in argon and the predicted value obtained from momentum considerations. (Contractor's abstract)

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

A REVIEW OF RECENT MHD GENERATOR WORK AT THE AVCO-EVERETT RESEARCH LABORATORY by T. R. Brogan, J. F. Louis and others. Mar. 28, 1962, 20p. incl. illus. diagrs. (AFOSR-2352) (AF 49-(638)1129) AD 275803 Unclassified

Also published in Engineering Aspects of Magnetohydrodynamics, Proc. of Third Symposium, Rochester, N. Y. (Mar. 28-29, 1962), New York, Gordon and Breach, 1964, p. 243-258.

Conceptual plant design, electrical properties of gases, generator fluid mechanics and performance, field coil designs, and long duration testing are reviewed. In the area of gas properties, the experimentally determined conductivity of seeded combustion products is in good agreement with predicted values in the temperature range between 2300 to 3000°K. The study of generator fluid mechanics continued using the Mark II combustion generator. Successful operation at Hall coefficients up to 2 was achieved. Actual performance of the Mark II

generator is discussed. The discovery of high field strength superconducting alloys has important implications for MHD power generation, as well as for many other MHD devices. There is a brief description of these coils as applied to MHD generators, together with an assessment of the economic possibilities they present for use in a power plant. (Contractor's abstract)

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

DEVIATION OF MAST OPERATION FROM ONE-DIMENSIONAL MODEL, by F. J. Fishman and H. E. Petschek. Apr. 1962, 20p. incl diagrs. refs. (Research rept. no. 126) (AFOSR-2948) (AF 49(638)61 and AF 49(638)1129) Unclassified

Also published in Phys. Fluids, v. 5: 1188-1195, Oct. 1962. (AFOSR-65-0567; AD 437164)

In the magnetic annular shock tube (MAST), the gas is pushed axially along the annular space between concentric cylinders by an azimuthal magnetic field. Since a vacuum azimuthal magnetic field varies inversely as the radius, there is a variation in the driving pressure across the annulus, which leads to radial nonuniformities in the flow. These are analyzed for small ratios (ϵ) of the annulus spacing to the radius. This pressure variation across the annulus at the interface between the plasma and the driving field results in a tilting of the interface. This tilting is shown to be completely analogous to the flow resulting from a dam break in shallow water theory and is characterized by a wave of propagation speed $\sqrt{p/\rho}$. The maximum value of ϵ for which the tilted current sheet does not catch up with the shock wave is calculated and it is suggested that only MASTS with ϵ's smaller than this value produce reasonably uniform flow regions. Nonuniformities are also produced at the shock front when an azimuthal magnetic field is present ahead of the shock. These lead to a nonplanar shock front whose shape is calculated, and to nonuniform conditions in the plasma behind the shock. The nonuniformities which persist far behind the shock are computed, these results indicate that for low shock Mach numbers appreciable nonuniformities in pressure and temperature exist even for fairly small values of ϵ. (Contractor's abstract)

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

DEVIATION OF MAGNETIC ANNULAR SHOCK-TUBE OPERATION FROM ONE-DIMENSIONAL MODEL, by F. J. Fishman and H. E. Petschek. [1962] [8]p. incl. diagrs. refs. (AFOSR-65-0567) (AF 49(638)61 and AF 49(638)1129) AD 437164 Unclassified

Also published in Phys. Fluids, v. 5: 1188-1195, Oct. 1962.

For abstract see item no. 102, Vol. VI.

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

ELECTRONIC AND RADIATIVE HEAT TRANSFER (Abstract), by M. Camac and R. [M.] Feinberg. [1962] [1]p. [AF 49(638)1129] Unclassified

Presented at meeting of the Amer. Phys. Soc., Northwestern U., Evanston, Ill., June 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 406, June 19, 1962.

An investigation of electronic and radiative heat transfer from plasmas to solid surfaces has been undertaken with the use of the infrared heat-transfer gauge (item no. 74, Vol. V). Argon at an initial pressure of 1 mm Hg was shock-heated in a chemically driven shock tube. The shock velocity ranged from 3 to 6 mm/μsec. Plasma and radiative heat transfer behind the reflective shock was measured at the end plate of the shock tube. The degree of ionization of the argon varied from 10 to 60%. The main contribution to the plasma heat transfer was due to the electronic and ionic components which is more than four times that for neutral argon. The measurements are in good agreement with the theory of Kemp and Fay. The radiation heat transfer from the ionized argon (mainly Kramer's radiation) was also measured, from which the rate of cooling of the argon by radiation was determined.

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

EXPERIMENTS WITH A MAGNETIC ANNULAR ARC (Abstract), by W. E. Powers and R. M. Patrick. [1962] [1]p. [AF 49(638)1129] Unclassified

Presented at meeting of the Amer. Phys. Soc., Northwestern U., Evanston, Ill., June 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 413-414, June 19, 1962.

The arc consists of two coaxial electrodes separated by an annular passage through which helium or argon plasma flows with a steady solonoidal magnetic field. The impedance of this device was increased due to Hall effects by factor of 25 with the application of an axial magnetic field. The magnetic Reynolds number was small. The interaction between the plasma currents and the magnetic field has produced directed energy comparable to the thermal energy. The plasma was rotated in a constant area, uniform field configuration. A 10° half-angle nozzle was added and plasma properties were measured at the nozzle exit. Recently, a 50° half-angle nozzle configuration has been studied in which most of the plasma currents flow in the nozzle. Axial energy is produced through the interaction of the circulating Hall currents and the radial component of the magnetic field. Stagnation pressures and local electric potentials were measured in the steady flow. Plasma currents were obtained by measuring the difference between the voltage output of 2 identical coils orientated to give the local magnetic field gradient.

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

SHOCK TUBES FOR HIGH TEMPERATURE GAS KINETICS, by A. [R.] Kantrowitz. Oct. 1962, 51p. incl. illus. diagrs. tables, refs. (Research rept. no. 141) [AF 49(638)1129] AD 291409 Unclassified

Also published in Energy Transfer in Gases, Twelfth Chemistry Conf. of the Solvay Institute, Brussels (Belgium) (Nov 5-10, 1962), ed. by R. Stoops. New York, Interscience Publishers, 1962, p. 241-285.

The essential advantage of shock tubes over electrical discharge devices is the capability to produce a homogeneous gas sample (HGS) with enthalpy and pressure which can be dependably calculated from the measured shock velocity and the conservation laws. This paper is concerned with setting forth the variety of conditions which can be reached and the precision and dimensions of the HGS which can be produced. Diaphragm type shock tubes are capable of heating gases to temperatures sufficient for the study of all chemical reactions and many electronic processes. The enthalpy and pressure of the gas sample can be calculated from the conservation laws with precision falling from 1 to 10%, moving from lower to higher temperatures. The advent of electromagnetically driven shock tubes opens up the possibility of achieving similar advantages at temperatures up to millions of degrees. An assessment is made in this paper of the degree to which an HGS has been produced in this temperature range.

107

Baird Atomic, Inc., Cambridge, Mass.

APPLICATION OF THE SENARMONT POLARISCOPE TO ANALYSIS OF OPTICAL MASER LIGHT, by D Hellerstein. [1962] [5]p. incl. illus. diagrs. (AFOSR-J974) (AF 49(638)1167) AD 417142 Unclassified

Presented at 1963 Spring meeting of the Amer. Opt Soc., Jacksonville, Fla.

Abstract published in Jour. Opt. Soc. Amer., v. 53: 515, Apr. 1963.

Also published in Appl. Opt., v. 2: 801-805, Aug. 1963.

A Senarmont polariscope suitable for optical maser work has been constructed. It employs an optically active wedge and an analyzing polarizer to map the azimuthal angle onto a linear field, indicating this angle by null positions on a photographic plate. It measures the azimuth of linearly polarized light over a range of 180° with an accuracy at present of ± 1.5° and distinguishes between right and left circularly polarized light. This device is compact, relatively inexpensive, and requires no auxiliary electronic apparatus. (Contractor's abstract)

108

Barcelona U. (Spain).

OBSERVABLES OF RELATIVISTIC PARTICLES, by L. M. Garrido and J. Sesma. [1962] [4]p. incl. diagr. (AFOSR-J226) (AF EOAR-62-89) AD 400857 Unclassified

Also published in Amer. Jour. Phys., v. 30 887-890, Dec. 1962.

The most general unitary transformation that transforms the Hamiltonians of particles of spins 0, ½, or 1 into Hamiltonians containing even or odd matrices is studied. Also presented are the expressions for the position operators for each transformation that are valid for the 3 kinds of particles mentioned above. (Contractor's abstract, modified)

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Barcelona U. (Spain).

ACTION PRINCIPLE FOR CLASSICAL FIELDS, by F. J. Sancho. [1962] [5]p. (AFOSR-J298) (AF EOAR-62-89) AD 408040 Unclassified

Also published in Physica, v. 28: 1324-1328, Dec. 1962.

An action principle presented by Garrido (see item no. 3201, Vol. V) for discrete systems is extended to classical field theory.

110

Barcelona U. (Spain).

GENERAL THEORY OF PERTURBATIONS IN CLASSICAL MECHANICS, by L. M. Garrido and F. Gascon. [1962] [7]p. incl. diagr. (AFOSR-J916) (AF EOAR-62-89) Unclassified

Also published in Proc. Phys. Soc. (London), v. 81: 1115-1121, June 1, 1963.

An operational method is presented for studying the effect of perturbations in classical mechanics. This method is similar to that used in quantum mechanics. Hamilton's formalism is then used. The most general case when the unperturbed Hamiltonian and the perturbed Hamiltonian depend explicitly on time is explained. This theory is illustrated with an example. (Contractor's abstract)

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Battelle Memorial Inst., Columbus, Ohio.

AN INVESTIGATION OF THE EFFECTS OF VERY HIGH PRESSURE AND TEMPERATURE ON SEMICONDUCTING AND INSULATING MATERIALS, by C. M. Schwartz and A. P. Young. Final rept. June 15, 1958-Dec. 31, 1962 [8]p. (AFOSR-4407) (AF 49(638)-441) AD 295834 Unclassified

This research program is directed towards obtaining fundamental knowledge of the structure and behavior of solid as well as gaining new insight into profitable areas of future research in which new materials may be synthesized in an environment utilizing high pressures and temperatures. In situ measurements of electrical conductivity and thermoelectrical power of such solids as NiO, BeO, etc. having marked differences in zone structure are presented. These data may lead to the selection of additional oxides of the type RO, RO_2, R_2O_X, etc.

112

Battelle Memorial Inst., Columbus, Ohio.

SYNTHESIS AND PROPERTIES OF A HIGH-PRESSURE RUTILE-TYPE $AlAsO_4$, by A. P. Young, C. B. Sclar, and C. M. Schwartz. [1962] [10]p. incl. illus. diagrs. tables, refs. (AFOSR-J1598) (AF 49(638)441) AD 427629 Unclassified

Also published in Zeitschr. Krist., v. 118: 223-232, June 1963.

A rutile-type $AlAsO_4$ polymorph with a = 4.359A and c = 2.815A has been synthesized at 90 kbar and 900°C. The density is 5.15 $g\ cm^{-3}$, an increase of 54% over the quartz modification. The indices of refraction of the rutile form of $AlAsO_4$ are ϵ = 1.950, ω = 1.905, both ±0.005. Molar refraction data for the quartz and rutile polymorphs of $AlAsO_4$ show a percentage decrease

of 10.4 relative to the quartz form and fulfill the Dachille-Roy prediction relating molar refraction and cation coordination. The main absorption band of the infrared spectra of the quartz and rutile forms of $AlAsO_4$ shows a shift of 23% in the direction of increasing wavelength with increasing cation coordination. A corresponding shift of the same magnitude is shown by the quartz and rutile forms of SiO_2 and GeO_2. (Contractor's abstract)

113

Battelle Memorial Inst., Columbus, Ohio.

SYNTHESIS AND OPTICAL CRYSTALLOGRAPHY OF STISHOVITE, A VERY HIGH PRESSURE POLYMORPH OF SiO_2, by C. B. Sclar, A. P. Young and others. [1962] [6]p. incl. illus. tables, refs. (AFOSR-J1605) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)441 and [Atomic Energy Commission]) AD 427705 Unclassified

Also published in Jour. Geophys. Research, v. 67: 4049-4054, Sept. 1962.

Stishovite, a high-pressure high-density polymorph of SiO_2, isostructural with rutile, was synthesized at pressures between 75 and 125 kb and temperatures greater than 900°C. Significant conversion to the rutile form was obtained in a modified girdle apparatus at 125 kb; trace amounts were obtained in a belt-type apparatus between 75 and 100 kb. Stishovite is colorless, acicular in habit, and uniaxial positive with $\epsilon = 1.845 \pm .005$, $\omega = 1.800 \pm .005$. The optic axis is commonly highly inclined to the morphological axis. The transformation of coesite (4-fold coordination) to stishovite (6-fold coordination) exemplifies the decrease in molar refraction with increasing coordination predicted by Dachille and Roy. (Contractor's abstract)

114

Battelle Memorial Inst., Columbus, Ohio.

HIGH PRESSURE FORMS OF $CrVO_4$ AND $FeVO_4$, by A. F. Young and C. M. Schwartz. [1962] [1]p. incl. tables. (AFOSR-J1606) (AF 49(638)441) AD 427642 Unclassified

Also published in Acta Cryst., v. 15: 1305, Dec. 10, 1962.

$CrVO_4$ and $FeVO_4$ were synthesized by heating mixtures of $Cr_2O_3 + V_2O_5$ and $Fe_2O_3 + V_2O_5$, respectively, at 750°C and 60,000 atm for 24 hr. The high-pressure form of $CrVO_4$ has a rutile structure with a = 4.551, c = 2.884A (1 mol per unit cell). (The normal form is orthorhombic) The normal form of $FeVO_4$ gives a very complicated x-ray diffraction pattern and the crystal structure has not been determined. The high-pressure form, however, gave a much simpler diffraction pattern which can be indexed on the basis of an orthorhombic unit cell with dimensions, a = 4.491, b = 4.900, c = 5.530A (probably 2 mol per unit cell). The density of the high-pressure form of $CrVO_4$ is 13.7% higher than that of the normal form.

115

Battelle Memorial Inst., Columbus, Ohio.

TEMPERATURE FLUCTUATIONS DURING GROWTH AND IMPURITY SEGREGATION IN InSb CRYSTALS, by N. Albon. [1962] [2]p. incl illus. (AFOSR-3999) (AF 49(638)959) AD 405501 Unclassified

Also published in Jour. Appl. Phys., v. 33: 2912-2913, Sept. 1962.

A preliminary study of the relation between temperature fluctuations during growth and impurity segregation in InSb crystals has been made. The observations described here, together with measurements of the thermal gradients during growth confirm that temperature changes expected to result from rotation are sufficient to produce the observed striations. In addition, these experiments indicate that an adverse effect on the uniformity of InSb crystals is produced by temperature fluctuations of less than 1°C if the rate of temperature change is sufficiently rapid. They also suggest that by melting temperature changes during crystal growth and precise measurements of the resulting impurity profiles in the growth direction, the relation between rate of growth and supercooling could be determined. This would indicate the growth mechanisms involved.

116

Battelle Memorial Inst., Columbus, Ohio.

STUDIES OF THE InSb CRYSTAL-MELT INTERFACE, by N. Albon. [1962] [4]p. incl. illus. refs. (AFOSR-64-2103) (AF 49(638)959) AD 451567 Unclassified

Presented in part at meeting of the Electrochemical Soc., Boston, Mass., Sept. 16-20, 1962.

Abstract published in Jour. Electrochem. Soc., v. 109: 202C, Aug. 1962.

Also published in Jour. Electrochem. Soc., v. 111: 61-64, Jan. 1964.

The InSb interface was studied by microscopical examination of crystals decanted from the melt. Crystals which had been allowed to approach equilibrium at a curved isotherm showed facets on which the features could be correlated with crystal growth mechanisms. On the curved areas of the interface, lines having a regular spacing were observed, which previously have been assumed to be growth steps. The lines were shown to be grooves without a definite crystallographic orientation and evidence against their origin during the crystal growth process was obtained. (Contractor's abstract)

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Battelle Memorial Inst., Columbus, Ohio

FORMATION OF CONICAL HILLOCKS ON CRYSTALS (Abstract), by S. E. Miller and N. Albon. [1962] [1]p. (AF 49(638)959) Unclassified

Presented at meeting of the Electrochemical Soc., Boston, Mass., Sept. 16-20, 1962

Published in Jour. Electrochem. Soc., v. 109: 202C, Aug. 1962.

Recent microscopic examinations of high-purity GaAs crystals, prepared by the horizontal gradient-freeze technique, have revealed a multitude of minute conical hillocks on the surface of the ingots The hillocks are also quite prominent on InAs, InP, and GaP, and to a lesser degree on InSb and GaSb. A detailed description of the phenomena is presented illustrated with photomicrographs. (Contractor's abstract)

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Battelle Memorial Inst , Columbus, Ohio.

IMPURITY LEVELS ASSOCIATED WITH SUBSIDIARY CONDUCTION BANDS IN NARROW GAP III-V COMPOUNDS (Abstract), by R. T. Bate. [1962] [1]p. [AF 49(638)959] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md , Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 214, Mar. 26, 1962

It is well established that the principal conduction-band minimum occurs at k = 0 in several III-V semiconductors The effective mass in this minimum is relatively small, and shallow impurity levels associated with this minimum are not observed even in the purest samples except in strong magnetic fields, presumably because of overlap of orbits. However, there is considerable evidence for the existence of subsidiary minima at other points in the Brillouin zone in many of these compounds. An extension of the simple theory of shallow impurity states taking these minima into account predicts the occurrence of impurity levels below each minimum but above the principal band edge Because the effective masses in these minima are relatively large, the orbits are smaller and the ionization energies are larger than for the minimum at k = 0. Although removing an electron from one of these bound states does not necessarily require a net increase in its energy if it simultaneously makes a transition to the central band, the bound electrons do not contribute to the conductivity because the interband transition, which requires a large change in wave vector, will not be induced by the electric field.

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Battelle Memorial Inst., Columbus, Ohio.

GRAIN-BOUNDARY DIFFUSION OF GOLD IN COPPER, by A. E. Austin and N. A. Richard. [1962] [6]p. incl. diagrs. tables. (AFOSR-3013) (AF AFOSR-61-107) AD 278377 Unclassified

Also published in Jour. Appl. Phys., v. 33: 3569-3574, Dec. 1962.

The diffusion of Au into the grain boundaries of Cu bicrystals was studied for couples of both a continuous and an instantaneous source. The concentration contours along the grain boundaries were measured by means of electron-probe microanalysis. For the continuous source conditions at 750°C, the ratio of the coefficients of grain-boundary diffusion and lattice decreased from 6×10^5 to about 10^3 with increasing Au concentration from 0.5 to 15 at-% Au. The rate of grain-boundary diffusion decreases even though there is some increase in the rate of lattice diffusion. There was found some contribution of surface diffusion to the couples with an instantaneous or thin source, i.e., 0.5μ thick. The concentration contours observed in these couples agreed generally with the theoretical solutions. (Contractor's abstract)

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Battelle Memorial Inst., Columbus, Ohio.

THEORETICAL SOLUTIONS OF GRAIN-BOUNDARY DIFFUSION PROBLEM. APPROXIMATIONS AND INTERPRETATION OF EXPERIMENTS, by V. E. Wood, A. E. Austin, and F. J. Milford. [1962] [6]p. incl. diagrs. tables. (AFOSR-3014) (AF AFOSR-61-107) AD 280776 Unclassified

Also published in Jour. Appl. Phys., v. 33: 3574-3579, Dec. 1962.

Whipple's exact solution to the idealized grain-boundary diffusion problem has been evaluated numerically for ranges of parameters appropriate to existing and contemplated experiments. From these evaluations the concentration at fixed depth of penetration, and the angle at which isoconcentration contours intersect the grain boundary are obtained. The ranges of validity of approximate solutions obtained by various authors are discussed on the basis of the numerical results, as is the use of the graphs and tables for the interpretation of experimental data.

121

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

PSYCHOPHYSICS, REALITY AND HALLUCINATIONS, by S. Goldstone. [1958] [14]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)79] and Public Health Service) Unclassified

Published in APA-AAAS Symposium on Hallucinations, Washington, D. C. (Dec. 27-28, 1958), New York, Grune and Stratton, 1962, p. 261-274.

An analysis is made of available data in order to suggest possible basic psychological mechanisms that may underlie the process of hallucinating. Specifically, an attempt is made to present a phychophysical point of view that departs from the classical stimulus-centered sensory psychology, and to demonstrate the potential of the relevant methods and formulations that permit the derivation of quantitative information about the functioning and malfunctioning of internal standards or concepts. In addition, a fanciful excursion departing from data already available will allow the suggestion of 2 mechanisms that may in part account for hallucinations: (1) a partial reduction in intersensory stimulus differentiation such that an adequate stimulus received by one mode may be interpreted in terms of a less appropriate mode and (2) a partial reduction in the subject's ability to make contemporary use of past experience because his internal standard has become less available or less vivid.

122

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

IN VIVO BIOGENESIS OF THYROID HORMONE IN THE GUINEA PIG, by W. J. Schindler and C. Fortier. [1962] [6]p. incl. illus. (AFOSR-841) (AF 49(638)384) AD 407378 Unclassified

Also published in Canad. Jour. Biochem. and Physiol., v. 40: 1541-1546, Nov. 1962.

As a preliminary to a study of in vitro thyroid activity in the guinea pig, it was considered of interest to assess this activity in vivo. Uptake and organic binding of radioiodine (I^{131}) by the guinea pig thyroid were studied as ordinates of time following administration of the tracer, by means of electrophoretic, autoradiographic, and chromatographic techniques. Similar techniques were used to ascertain the nature of the iodinated compounds in the gland at the time of maximal uptake (Contractor's abstract)

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

[EFFECT OF THYROXINE PRETREATMENT ON THE UPTAKE AND ORGANIFICATION OF RADIOACTIVE IODINE BY INCUBATED THYROID FRAGMENTS OF GUINEA PIGS] Effet du prétraitement à la thyroxine sur la captation et l'organification de l'iode radioactif par segments incubés de thyroïdes de cobayes, by C. Fortier and W. J. Schindler. [1962] [9]p. incl. illus. diagrs. tables. (AFOSR-3473) (In cooperation with Laval U., Quebec (Canada), under AF AFOSR-61-15) (AF 49(638)384) AD 407243 Unclassified

Also published in Laval med., v. 33: 506-515, Sept. 1962.

The uptake and organification of radioactive iodine by the incubated thyroid fragments of guinea pig are accelerated by the addition of thyrotropine. The administration of thyroxine for 10 days markedly increased the amplitude of the response to thyrotropine. Radiochromatographic analysis of incubated thyroid extracts showed that the organification of radioactive iodine, under these conditions, is arrested at the point of monoiodotyrosine and diiodotyrosine and that the iodination of mono- and diiodo-tyrosine is accelerated by thyrotropine. After pretreatment with thyroxine, a linear relation was observed between the response of the incubated thyroid and the logarithm of the dosages of thyrotropine. The system considered forms the basis of a simple, specific and relatively exact method for standardizing thyrotropine.

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Bell Aircraft Corp., Buffalo, N. Y.

LOW TEMPERATURE PLASMA PHENOMENA, by R. J. Whalen and K. Pearch. [1959] [19]p. incl. diagrs. table. (AFOSR-3741) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)380 and Wright Air Development Center) Unclassified

The non-equilibrium nozzle expansion process for oxygen and air is examined in 4000°K ≤ to ≤ 14,000°K, $1 \leq \rho \leq 1000$ atm range. Byron's recombination rate law for oxygen is employed throughout the analysis. The influence of variation in the magnitude of the rate constant, and various decay rates are considered. The influence of nozzle geometry is also discussed. It is shown that for large departures from equilibrium the Mach number is significantly larger than the equilibrium value. For ρ_0 = 10 atm, T_0 = 8000°K, M > 100 is obtained. Normal and oblique shock pressure, density, temperature ratios are presented for ρ_0 = 10, 100, and 1,000 and for T_0 = 8000°K. The correlation of fully dissociated flows with γ = 5/3 M prediction is also presented. The large influence on stagnation point heat transfer for a catalytic surface is discussed. The similitude for the inviscid hypersonic flow of a chemically reacting gas about a slender 2-dimensional geometry is presented. Correlation of the equilibrium and nonequilibrium calculation with the similitude offers a procedure for determining M in nonequilibrium gas flows. Finally, the importance and influence of magnetohydrodynamic effects for $V \perp B$, where V = (U, 0, 0), B = (0, B, 0), in the range of temperature and pressure associated with the fully dissociated expansion is presented. (Contractor's abstract)

125

Bern U. Inst. of Physics (Switzerland).

RADIATION EFFECTS IN SPACE AND THERMAL EFFECTS OF ATMOSPHERIC ENTRY BY THERMOLUMINESCENCE MEASUREMENTS ON METEORITES, by F. C. Houtermans. Oct. 1, 1962 [30]p. incl. diagrs. tables, refs. (AFOSR-4059) (AF EOAR-61-51) AD 290613 Unclassified

The natural glow-curves of 19 chondrites were

measured and compared with the corresponding artificial glow-curves, obtained after irradiation with a β-dose of 5×10^4 rad. The differences between the natural and the artificial glow-curves as well as the increase of peak-temperature with decreasing peak-intensity, observed for the natural glow-curves of the various chondrites, can be explained by thermal effects. Either a temperature raise occurred before, during, or after the fall of the meteorites, which caused the low-temperature part of the natural glow-curves to fade out, or the shallow, low-energy traps, responsible for the low-temperature part of the natural glow-curves never were filled, due to the low dose rate of cosmic radiation. Larger differences between the glow- curve of achondrites are observed. The artificial glow-curves of the calcium rich, basaltic type achondrites are distinctly different from those the calcium-poor, chondritic type achondrites. A steady decrease of the intensity of the natural thermoluminescence with decreasing Ar k-ages is observed. (Contractor's abstract)

126

Biot, M. A., New York.

EXACT THEORY OF BUCKLING OF A THICK SLAB, by M. A. Biot. [1961] [16]p. incl. diagrs. (AFOSR-1770) (AF 49(638)837) AD 441479 Unclassified

Also published in Appl. Scient Research, v. 12A: 183-198, 1963.

The incremental elastic coefficients for rubbertype elasticity are inserted in some earlier theories by the author leading to an exact theory for the buckling of a thick slab in finite strain. The critical compression as a function of the wave length shows a continuous variation. The buckling is of the bending type at large wavelengths and becomes a shear type instability for shorter slabs. In the limiting case of vanishing wavelength the buckling degenerates into a surface instability. The formal behavior is analogous to the transition from bending waves to Rayleigh waves in the vibration of elastic plates. The range of validity of the classical Euler theory is discussed and stress distributions across the thickness are evaluated. The problem is also treated by an approximate variational procedure and it is shown that a very simple bending-sheartype deformation yields a remarkable accurate formula through the complete range of wavelengths. (Contractor's abstract)

127

Biot, M. A., New York.

SURFACE INSTABILITY OF RUBBER IN COMPRESSION, by M. A. Biot. [1961] [15]p. incl. table, refs. (AFOSR-1771) (AF 49(638)837) AD 450005 Unclassified

Also published in Appl. Scient. Research v. 12A: 168-182. 1963.

Expressions for the incremental elastic coefficients of an isotropic medium under initial stress are applied to rubbertype elasticity. As a corollary an exact theory is obtained for the surface instability of such material under compression. It is found that in plane strain the incremental properties remain isotropic and are characterized by a single strain-dependent modulus. In 3-dimensional strain the elastic properties are found to coincide with those of the elastic medium introduced by Green to illustrate the properties of electromagnetic propagation. The apparent rigidity of the surface as a function of strain is evaluated and is shown to result from the combined effect of the variation of rigidity modulus and a membrane effect due to the initial stress. At a critical compression the 2 effects act in opposite directions and the apparent surface rigidity vanishes causing incipient instability. The phenomenon is formally analogous to Rayleigh waves. Attention is also called to the existence of interfacial instability at a surface of discontinuity of 2 elastic media under initial stress in analogy with Stoneley waves. (Contractor's abstract)

128

Biot, M. A., New York.

INCREMENTAL ELASTIC COEFFICIENTS OF AN ISOTROPIC MEDIUM IN FINITE STRAIN, by M. A Biot. [1961] [17]p. incl. diagrs. (AFOSR-1772) (AF 49-(638)837) AD 452448 Unclassified

Also published in Appl. Scient. Research, v. 12A: 151-167, 1963.

Incremental elastic coefficients are derived for an isotropic medium in a state of finite initial strain. The analysis is based on concepts and methods developed by the author in earlier publications which require only elementary procedures and bring to light the physical significance of the results. Remarkedly simple formulas for the incremental shear coefficients are established. For comparison the same results are derived by an alternate procedure using Riemannian tensors and the calculation is shown to be much more elaborate. Application is made to the particular case of second order elasticity theory and expressions derived for the incremental coefficients including the correction terms of the first order in the initial strain. This provides a complete theory of first order correction for acoustic propagation under initial stress. (Contractor's abstract)

129

Biot, M. A., New York.

ACOUSTIC-GRAVITY WAVES AS A PARTICULAR CASE OF THE THEORY OF ELASTICITY UNDER INITIAL STRESS, by M. A. Biot. [1962] [3]p. (AFOSR-J1030) (AF 49(638)837) AD 419870 Unclassified

Also published in Phys. Fluids, v. 6: 778-780, June 1963.

General equations for acoustic-gravity waves in a fluid

are derived as a particular case of the theory of elasticity of initially stressed continua. The differential equations for the fluid dynamics and the corresponding variational principles are obtained. The transition from solid to fluid is illustrated for the special case of a constant gravity field. The dynamics of a fluid under initial stress is thus brought within the scope of the theory of elasticity providing a unified treatment of wave propagation in composite fluid-solid systems. (Contractor's abstract)

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Biot, M. A., New York.

GENERAL FLUID-DISPLACEMENT EQUATIONS FOR ACOUSTIC-GRAVITY WAVES, by M. A. Biot. [1962] [6]p. (AFOSR-J1031) (AF 49(638)837) AD 419709 Unclassified

Also published in Phys. Fluids, v. 6: 621-626, May 1963.

General equations are derived for the dynamics of a fluid under initial stress in an arbitrary potential field and perturbed from equilibrium. The motion is described in terms of the displacements of the fluid particles from their equilibrium position. A class of equations is obtained which is applicable to large displacements. Complete linearization leads to 2 types of equations. One type called unmodified corresponds to the viewpoint of the theory of elasticity. The modified equations representing the other type are expressed in terms of buoyancy forces. The modified equations lead to a conceptually useful analog model for internal gravity waves in a liquid. For a constant gravity field the linear equations are also applicable to large displacements. Classical examples for a constant gravity field are discussed as illustrations. (Contractor's abstract)

131

Biot, M. A., New York.

VARIATIONAL PRINCIPLES FOR ACOUSTIC-GRAVITY WAVES, by M. A. Biot. [1962] [7]p. (AFOSR-J1032) (AF 49(638)837) AD 419884 Unclassified

Also published in Phys. Fluids, v. 6: 772-77-, June 1963.

Variational principles are developed for the dynamics of a fluid under initial stress in an arbitrary potential field and disturbed from equilibrium. They are formulated in terms of fluid displacement. Two distinct principles are obtained which are mathematically equivalent but differ fundamentally from the physical viewpoint. The difference results from expressing the potential energy in terms of buoyancy forces or strain energy. A very general stability criterion is obtained. An important new feature is the inclusion of surface integrals in the potential energy. The simplified principle for the case of a liquid is interpreted by means of an analog model. Lagrangian equations and methods of normal coordinates for the evaluation of transient propagation are applicable along with general theorems on the equivalence of group velocity and energy flux. As an illustration the case of a constant gravity field is discussed. (Contractor's abstract)

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

RESEARCH IN MICROWAVE SPECTROSCOPY, by J. Sheridan, A. P. Cox, and J. K. Tyler. Final rept Jan. 1962 [37]p. incl. diagrs. tables. (AFOSR-2392) (AF 61(052)241) AD 273614 Unclassified

Refinements in methods of generation and detection of microwave harmonics at wavelengths down to the 1 - 2 mm region are discussed. Preferred methods are given for selection, shaping, mounting and adjustment of the point-contact diodes used. Other refinements of instrumentation have allowed the measurement of spectra of unstable and involatile molecules with the ability to resolve important hyperfine structures. New microwave spectroscopic measurements included evaluation of precise interatomic distances in fluorine cyanide and chloroacetylene, of electron-distribution properties of cyanamide and diazomethane from nuclear quadrupole effects, and the first precise structural information regarding nitramide in the gas phase. Refined values of centrifugal distortion constants were obtained for several molecules. (Contractor's abstract)

133

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

MICROWAVE SPECTRUM OF NITRAMIDE, by J. K. Tyler. Nov. 1962, 9p. incl. tables, refs. (AFOSR-4751) (AF 61(052)241 and AF EOAR-62-1) AD 418449 Unclassified

Microwave spectra have been measured for the isotopic species of NH_2NO_2, $NHDNO_2$, and ND_2NO_2. The nitroamine structure is confirmed and a nonplanar structure with an inverting $-NH_2$ group indicated. In all cases the Boltzmann factor for the inversion motion is indistinguishable from unity. Structural parameters obtained are. N - H = 1.005 ± 0.01A, N - N = 1.427 ± 0.002A, N - O = 1.206 assumed, ONO = 130° 8′ ± 15′, HNH = 115° 11′ ± 2°. Angle between NH_2 plane and NNO_2 plane = φ = 51° 47′ ± 1°. The μ_a component of the dipole moment is measured as 3.57 ± 0.05D. (Contractor's abstract)

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

BRIDGES OVER THE GULF BETWEEN MAN-MACHINE-SYSTEM RESEARCH AND MAN-MACHINE-SYSTEM DEVELOPMENT, by J. C. R Licklider. [1961] [12]p. (AFOSR-1127) (Bound with its AFOSR-1673: AD 424284) (AF 49(638)355) AD 424234 Unclassified

Also published in Applied Psychology; Proc. of the Fourteenth Internat'l. Cong., Copenhagen (Denmark) (Aug. 13-19, 1961), Munksgaard, v. 5: 214-229, 1962.

For abstract see item no. 135, Vol. VI.

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

THE SYSTEM SYSTEM, by J. C. R. Licklider. Jan. 1962 [18]p. (AFOSR-1673) (Bound with its A.FOSR-1127; AD 424284) (AF 49(638)355) AD 424284 Unclassified

Also published in Human Factors in Technology, ed. by E. Bennett, J. Degan, and J. Spiegel. New York, McGraw-Hill. 1963, p. 627-641.

The need for greater coherence in the man-machine and other high-order interactions of our major systems is described, and an approach to achievement of that coherence is proposed. The approach involves a computer-centered meta-system (the 'system system') designed to facilitate communication, coordination, and problem-solving. The needs for, and roles of, such a meta-system in various phases of system design, development, production, and operation are discussed. (Contractor's abstract)

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

THREE AUDITORY THEORIES, by J. C. R. Licklider. [1959] [104]p. incl. diagrs. tables, refs. [AF 49(638)-355] Unclassified

Published in Psychology: A Study of a Science, ed. by S. Koch. New York, McGraw-Hill, v. 1: 41-144, 1959.

In the field of psychoacoustics there are several "part" theories but no systematically formulated over-all theory. The following "part" theories are discussed in the hope that a common rubric will prepare the way for putting them together into something larger or reveal incompatibilities that stand in the way of synthesis: (1) A theory of signal detection; (2) A theory of speech intelligibility; and (3) A theory of pitch perception.

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

STUDIES IN THE ORGANIZATION OF MAN-MACHINE SYSTEMS, by J. C. R. Licklider. Dec. 1962 [19]p. incl. refs. (BBN rept. no. 970) (AF 49(638)355) AD 295166 Unclassified

The basic aim of this research has been to find ways of increasing the transfer of knowledge among system programs and ways of relating research results to system applications. The methods used have been an informal mixture of studying, discussing, formulating, writing, and trying to understand and advance to some degree the technique of representing ideas and interrelations in the form of computer programs. The main outcomes of the study of system organization were: (1) Recognition of a close analogy between large-scale military man-machine systems and systems of computer programs; (2) Recognition of computer programs; and (3) A set of ideas about how to exploit the analogy and the capabilities in substantive work on systems.

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

DIFFERENCES IN THE FUNCTIONS OF THE TWO CEREBRAL HEMISPHERE, by W. D. Neff. [1961] [3]p. (AF 49(638)1142) Unclassified

Published in Conf. on Interhemispheric Relations and Cerebral Dominance (Apr. 23-25, 1961), ed. by V. B. Mountcastle. Baltimore, Johns Hopkins Press, 1962, p. 196-198.

This report represents a brief comment on the contribution of animal experiments to understanding the problem of cerebral dominance. It is noted that experiments on lower animals have not, with few exceptions, contributed appreciably to an understanding of this problem. This may mean that researchers, study. of brain function by means of laboratory experiments on animals, have been concerned with other problems which are more readily attacked, and that they have only recently obtained knowledge and developed techniques which may lead to experiments which will look for interhemispheric differences.

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

DISCRIMINATORY CAPACITY OF DIFFERENT DIVISIONS OF THE AUDITORY SYSTEM, by W. D. Neff. [1961] [58]p incl. illus. diagrs. tables, refs. (In cooperation with Chicago U., Ill.) (AF 49(638)1142) Unclassified

Published in Brain and Behavior; Proc. of the First Conf., Los Angeles, Calif. (Feb. 19-22, 1961), ed. by M. A. B. Brazier. Washington, American Institute of Biological Sciences, v. 1: 205-262, 1961.

Several experiments involving bilateral ablation of subareas of the auditory cortex, large unilateral cortical ablations, and subcortical transections of auditory pathways are described. In the cat, the following results are obtained after bilateral ablation of subareas of the auditory cortex: (1) The ability to make learned responses to auditory signals is typically lost, if the ablation is made bilaterally in one-stage, but relearning of some discriminations is possible; (2) The capacity to detect onset of sounds at threshold intensities and to discriminate threshold changes in intensity is unchanged; (3) The capacity to respond to large changes in frequency remains; (4) A deficit occurs in capacity to discriminate changes in duration; and (5) A complete loss occurs in capacity to discriminate changes in temporal patterns of tones and to localize sound in

space. Experiments with the monkey produce similar results. Widespread ablation of auditory cortex of one cerebral hemisphere can produce a deficit in the capacity to localize sound in space. No effects of unilateral ablations have been noted in other discriminations. Unilateral transection of the brachium of the inferior colliculus in the cat produces a deficit in ability to localize sound in space. Other discriminations are probably unaffected. Bilateral transection of auditory pathways, at the level of the brachium of the inferior colliculus in the cat produces a change of approximately 10 decibels in the differential threshold for intensity. Bilateral transection at the level of the BIC in the cat does not produce a loss of capability to discriminate large changes in frequency if the lesion is confined to the BIC as defined. When the bilateral transection extends beyond the BIC so as to eliminate evoked responses at the cortex, there is a complete loss in capability to discriminate changes in frequency.

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

NEURAL STRUCTURES CONCERNED IN LOCALIZATION OF SOUND IN SPACE, by W. D. Neff. [1962] [9]p. incl. illus. diagrs. refs. (Also bound with its AFOSR-64-0966; AD 600222) (In cooperation with Chicago U., Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1142 and Office of Naval Research) Unclassified

Also published in Psycholog. Beitrage, v. 6: 492-600, 1962.

Results of experiments in which capacity to localize sound in space was measured before and after ablation of auditory cortex or transection of auditory pathways in the tectum are in line with the notion that auditory areas of the cortex (or perhaps, circuits area involving the medial geniculate body and cortical projection areas) are essential for processing information which is coded in terms of time relationships between nerve impulses. It is proposed that: (1) interaction of nerve impulses from the 2 ears must take place at the level of the medulla in order that accurate localization of sound in space can be made; (2) information based upon the interaction of nerve impulses from the 2 ears is transmitted upwards in a part of the auditory system and is coded as time differences between nerve impulses; and (3) the thalamo-cortical part of the auditory system is designed to receive the temporal information and to process it so that appropriate discriminatory behavior may result.

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Boston U. Dept. of Chemistry, Mass.

CHEMICAL PROPERTIES OF ACTIVE NITROGEN. I. THE REACTION OF ACTIVE NITROGEN WITH BUTADIENE. II. THE REACTION OF ACTIVE NITROGEN WITH ISOPRENE: A PRELIMINARY STUDY. III. STUDIES OF THE KINETICS OF DECAY OF ACTIVE NITROGEN, by A. Tsukamoto, M. H. Saxe, and J. Goldberg. Final rept. Sept. 1961 [44]p. incl. diagrs. tables, refs. (AFOSR-1459) (AF 49(638)2) Unclassified

Three separate groups of experiments are discussed in this final report. In Part I the gas phase reaction of active nitrogen and 1,3-butadiene was investigated. Pyrrole and cis- and trans-crotonitrile were obtained. They are considered to be the products of nondegradative reaction of active nitrogen. The reaction also yielded cis- and trans-1-cyano-1,3-butadiene and 3-cyano-1-butene. The reaction produces hydrogen cyanide as the major nitrogenous product as in all other hydrocarbon reactions with active nitrogen. Ethylene, acetylene and propylene are also formed. Two 6-carbon unsaturated nitriles were also isolated as was a polymer which contains C, H and N in the ratio C_4H_6N. In Part II the formation of nondegradative products from the reaction of active nitrogen with isoprene was briefly studied. Gas chromatographic analysis revealed that the reaction yields a complicated mixture. Four major products, besides hydrogen cyanide which is the main product of the reaction, were isolated and examined by infrared spectroscopy. Two of the major products were identified as 3-methyl-pyrolle and β-methyl-crotononitrile. Infrared spectra suggest that the other 2 are hydrocarbons. Effect of reaction conditions upon the yields of hydrocarbon cyanide and nondegradative products was briefly studied. Part III deals with the decay mechanism of active nitrogen. Special attention is given to wall decay.

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Boston U. Dept. of Chemistry, Mass.

STRUCTURES OF BORON COMPOUNDS, by K. Eriks. Final rept. Sept. 29, 1962 [41]p. incl. diagrs. tables, refs. (AFOSR-3785) (AF 49(638)65) Unclassified

The x-ray diffraction work contained in this report was undertaken to elucidate some of the structural properties of boron. The substances vary in nature, one being a metal boride, 2 being boron hydride derivatives and 2 donor-acceptor complexes of boron trihalides. Specifically the compounds to be described are: phosphine borane ($H_3P.BH_3$), trimethylphosphine borane ($(CH_3)_3P.BH_3$), dimethylsulfoxide-boron trifluoride ($(CH_3)_2SO.BF_3$), pyridine-boron trichloride ($C_5H_5N.BCl_3$), and aluminum dodecaboride (AlB_{12}). Aside from the structural studies this work has resulted in the design and construction of an integrating photodensitometer based on a photoelectric semiconductor, for estimation of intensities on x-ray films.

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Boston U. Dept. of Chemistry, Mass.

THE MOLECULAR AND CRYSTAL STRUCTURE OF PHOSPHINE BORANE, $H_3P.BH_3$, by E. L. McGandy and K. Eriks. [1959] [10]p. incl. diagrs. tables, refs. (Bound with its AFOSR-3785) (AF 49(638)65) Unclassified

Presented at Summer meeting of the Amer. Crystallographic Assoc., Ithaca, N. Y., July 1959.

Structural determinations of $H_3N.BH_3$[2] and of $(CH_3)_3NBH_3$[3] have been reported. While trimethylamine borane crystallizes in a space group having threefold symmetry, allowing straightforward determination of all atomic parameters, the space group of ammonia borane is tetragonal and it is concluded that essentially free molecular rotation occurs in crystals of that substance at room temperature. The purpose of this study is to establish to what extent the phosphorous complexes of BH_3 show a similarity to those of nitrogen. Crystals of phosphine borane were prepared and refined. The structure was obtained from the refinement and verified by means of a three-dimensional electron density map and a difference map. Final parameters for the model and observed and calculated structure factors are presented in table form.

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Boston U. Dept. of Chemistry, Mass.

MOLECULAR AND CRYSTAL STRUCTURE OF TRIMETHYLPHOSPINE-BORANE $(CH_3)_3P.BH_3$, by R. Thomas and K. Eriks. [1959] [4]p. incl. table. (Bound with its AFOSR-3785) (AF 49(638)65) Unclassified

Presented at Summer meeting of the Amer. Crystallographic Assoc., Ithaca, N. Y., July 1959.

Since preliminary work on trimethylphosphine-borane showed the structure to be disordered, experiments were performed to establish the existence of a different crystal form at lower temperatures. Two dimensional calculations were started first, using 21 observed hol reflections. A Patterson map could be interpreted with 2 alternative models. The models gave identical phases for 13 reflections. A Fourier map calculated with these 13 phases gave an acceptable model for the structure: the 2 molecules in the unit cell are aligned with their P-B axis parallel to the c (=4 fold) axis. The phosphorous atom is tetrahedrally surrounded, the 3 carbon atoms lying in a plane parallel to a - b. The carbon atoms are thought to be distributed over at least 4 equivalent points or, alternatively, to undergo free or hindered rotation around the P-B axis. No distinction can be made between those 2 possibilities on the basis of x-ray data alone. With this model the calculations could be extended to include all hol-reflections. A Fourier map computed after some refinement gave 1.94A for the P-B distance and approximately 1.91A for the P-C distance. Complete three dimensional refinement was undertaken on the statistically distributed model. The lowest value obtained for $R = \Sigma(|Fo| - |Fo|)/\Sigma|Fo|$ was 0.25.

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Boston U. Dept. of Chemistry, Mass.

CRYSTAL STRUCTURE OF PYRIDINE-BORON TRICHLORIDE, $C_5H_5N.BCl_3$, by S. A. Brenner. [1962] [5]p. incl. table. (Bound with its AFOSR-3785) (AF 49-(638)65) Unclassified

Crystals of pyridine-boron trichloride were prepared and cell dimensions were obtained by least squaring the parameter values from 31 observed powder peaks. The cell dimensions thus found are: a = 0.04(0)A, b = 15.3(2)A, c = 6.16(1)A, and α = 102°50′. There are 4 molecules of $C_5H_5N.BCl_3$ in this unit cell, leading to a calculated density D_x = 1.58 grcm^{-3}. Absences observed on the Weissenberg films lead to the space group $P^{2_1}/n(C_{2_h}^5)$.

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Boston U. [Dept. of Physics] Mass.

STOCHASTIC PROCESS OF KEILSON AND STORER, by A. Shimony. [1962] [2]p. (AFOSR-J1305) (AF AFOSR-62-177) AD 424842 Unclassified

Also published in Phys. Fluids, v. 6: 590-591, Apr. 1963.

The results of Keilson and Storer on an idealization of Brownian motion are derived more simply by showing that their assumptions are equivalent to a stochastic process.

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Brandeis U., Waltham, Mass.

ANTIBODIES TO DENATURED DEOXYRIBONUCLEIC ACID IN LUPUS ERYTHEMATOSUS SERUM. V. MECHANISM OF DNA-ANTI-DNA INHIBITION BY CHLOROQUINE, by D. Stollar and I. Levine. [1962] [7]p. incl. diagrs. tables, refs. (Publication no. 205) (AFOSR-5063) (Sponsored jointly by Air Force Office of Scientific Research, American Cancer Society, and National Institutes of Health) AD 413969 Unclassified

Also published in Arch. Biochem. and Biophys., v. 101: 335-341, May 1963.

Chloroquine inhibits the reaction of denatured DNA with lupus erythematosus sera, as measured by quantitative C' fixation. This inhibition differs from that caused by nucleotides; all DNA immune systems are inhibited by the drug to about the same extent. Inhibition of this reaction by several analogs of chloroquine was studied. The binding of chloroquine and certain structural analogs to DNA was measured. Inhibitory effectiveness is closely correlated with the association constants of the compounds for DNA. Chloroquine also inhibits bacterial transformation by DNA. (Contractor's abstract)

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Brandeis U., Waltham, Mass.

ANTIBODIES TO DENATURED DEOXYRIBONUCLEIC ACID IN A LUPUS ERYTHEMATOSUS SERUM, by D. Stollar and L. Levine. [1961] [8]p. incl. diagrs. refs. (Publication no. 113) (Sponsored jointly by Air Force

Office of Scientific Research, American Cancer Society, National Cancer Institute, and National Institutes of Health) Unclassified

Published in Jour. Immunol., v. 87: 477-484, Oct. 1961.

The reaction between the serum of a patient with disseminated lupus erythematosus and DNA has been studied by quantitative complement fixation. Thermally denatured DNA was shown to be a more reactive antigen than native DNA. Immunologic measurement of melting out and renaturation of the antigen characterized it as DNA. DNase-digested antigen preparations failed to react but were effective inhibitors. Lupus erythematosus (LE) serum detected serologic differences in denatured DNA preparations from various sources.

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Brandeis U., Waltham, Mass.

ANTIBODIES TO DENATURED DEOXYRIBONUCLEIC ACID IN LUPUS ERYTHEMATOSUS SERUM. IV. EVIDENCE FOR PURINE DETERMINANTS IN DNA, by D. Stollar and L. Levine. [1962] [6]p. incl. diagrs. tables, refs. (Publication no. 204) (Sponsored jointly by Air Force Office of Scientific Research, American Cancer Society, and National Institutes of Health) Unclassified

Published in Arch. Biochem. and Biophys., v. 101: 417-422, June 1963.

A lupus serum, G. B., reactive with relatively large amounts of denatured DNA preparations, has been characterized as containing antibodies directed to the DNA. RNA, polyriboadenylic acid, apurinic acid and partially digested DNA fail to react directly by C' fixation, but do react as measured by inhibition. Further inhibition studies show that the specificity of the antibodies in serum G. B. involve purines, and that polymers containing purines are not markedly more reactive than monomeric purines, nucleosides, and nucleotides. (Contractor's abstract)

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

KINETIC THEORY OF THE IMPULSIVE MOTION OF AN INFINITE PLANE, by E. P. Gross and E. A. Jackson. [1958] [11]p. incl. refs. (AFOSR-4157) (AF 49(638)27) Unclassified

Also published in Phys. Fluids, v. 1: 318-328, July-Aug. 1958.

For abstract see item no. BRU.01:008, Vol. II.

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

MOTION OF FOREIGN BODIES IN BOSON SYSTEMS, by E. P. Gross. [1962] [20]p. incl. refs. (AFOSR-4168) (AF 49(638)27) Unclassified

Also published in Ann. Phys., v. 19: 234-253, Aug. 1962.

The system studied is a foreign particle interacting with a gas of bosons. Particular attention is paid to the case of a foreign ion coupled to the atoms by a hard core potential plus a long range polarization potential. The essential features of the problem appear in a self-consistent field approximation. A finite fraction of the atoms is in a single particle state which is spatially inhomogeneous relative to the ion and forms a condensate. There is an enhanced density of bosons near the ion. The velocity flow pattern is such that the ion pushes fluid away directly ahead of itself, but there is a reversed dipolar flow far from the ion. The effective mass is very high; it is greater than the number of atoms contained in a volume $^4/_3\pi b^3$. The parameter b is the distance where the polarization energy becomes comparable to the boson-boson interaction energy. An outline is given of a systematic theory which includes corrections to the above-mentioned results arising from the zero-point energy shift of the oscillations of the coupled ion-boson system. (Contractor's abstract)

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

PARTICLE-LIKE SOLUTIONS IN FIELD THEORY, by E. P. Gross. [1962] [15]p. incl. refs. (AFOSR-4169) (AF 49(638)27) Unclassified

Also published in Ann. Phys., v. 19: 219-233, Aug. 1962.

A number of quantum field theories have the property that the field equations, studied as classical equations of motion, have particle-like solutions. These are spatially localized exact solutions, with a definite value of angular momentum. The role of these solutions in a fully quantum theory is the subject of investigation. In particular, the theory of a nonrelativistic scalar nucleon coupled by a local interaction to a scalar meson field is examined. The classical solution (whose spatial extent is a nucleon Bohr radius) is identified with a self-consistent field approximation to the one-nucleon state. However, quantum corrections to this approximation yield the same divergent self-energy as perturbation theory. In this example, the particle-like solutions have nothing to do with the ultraviolet divergences, but are relevant to the treatment of the definite part of the theory for strong coupling. The separation of the infinite part is trivial and is accomplished by a canonical transformation. The particle solutions will exist for the finite part for strong coupling. (Contractor's abstract)

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

DYNAMICS OF CLASSICAL MANY-BODY SYSTEMS, by E. P. Gross. [1961] [11]p. [AF 49(638)27] Unclassified

Published in Plasma Physics, Accelerators, Thermonuclear Research, v. 2: 173-183, Jan. 1961.

The present state of the theory of the propagation of small amplitude disturbances in monatomic gases and plasmas is discussed. The analysis is based on kinetic equations for 1-particle velocity distributions involving self-consistent field forces and Boltzmann-like collision terms. A microscopic formulation of the classical N-body problem is developed. The theory is used to analyze the meaning of earlier microscopic approaches, and carried to the point where the problem can be treated in a more fundamental way. (Contractor's abstract)

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

HYDRODYNAMICS OF A SUPERFLUID CONDENSATE, by E. P. Gross. [1962] [13]p. incl. refs. [AF 49(638)-27] Unclassified

Published in Jour. Math. Phys., v. 4: 195-207, Feb. 1963.

The theory of the condensate of a weakly interacting Bose gas is developed. The condensate is described by a wavefunction $\psi(x, t)$ normalized to the number of particles. It obeys a nonlinear self-consistent field equation. The solution in the presence of a rigid wall with the boundary condition of vanishing wavefunction involves a de Broglie length. This length depends on the mean potential energy per particle. The self-consistent field term keeps the density uniform except in localized spatial regions. In the hydrodynamical version, a key role is played by the quantum potential. A theory of quantized vortices and of general potential flows follows immediately. In contrast to classical hydrodynamics, the cores of vortices are completely determined by the de Broglie length and all energies are finite. Nonstationary disturbances of the condensate correspond to phonons, rotons, vortex waves etc. They can exchange momentum with rigid boundaries. This is compatible with the vanishing of the wavefunction at a boundary. This condition fully determines the dynamics of the system. These points are illustrated by considering the motion of a foreign ion in a Bose gas, a rotating container of fluid, and the Landau criterion for superfluidity.

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

NOTE ON UNIQUENESS OF CANONICAL COMMUTATION RELATIONS, by R. Arnowitt and S. Deser. May 1962, 3p. (AFOSR-J1451) (AF AFOSR-61-22) AD 427699 Unclassified

Also published in Jour. Math. Phys., v. 4: 615-617, May 1963.

It has been pointed out by Wigner that the consistency requirement between the Lagrange and Heisenberg equations of motion does not uniquely determine the canonical commutation relations, at least for 1-dimensional systems. It is shown that this ambiguity does not arise in local field theory whose basic equal-time commutators commute with the translation operator. (Contractor's abstract)

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

SELECTION RULES IMPOSED BY THE SYMMETRICAL SAKATA MODEL, by C. Iso. [1962] [10]p. incl. tables, refs. (AFOSR-64-0374) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-22 and National Science Foundation) AD 434533 Unclassified

Also published in Ann. Phys., v. 19: 314-322, Aug. 1962.

New selection rules for strangeness nonzero systems based on a symmetrical Sakata model are discussed. New operators, $G_{\Lambda p}$, (exchange of Λ and p) x (charge conjugation), and $G_{\Lambda n}$ (exchange of Λ and n) x (charge conjugation) are defined. It is shown that in some systems these operators define good quantum numbers and that new selection rules are obtained. These selection rules are applied to the processes:
$K^{0*} \to K^{+} + \pi^{-}$, $\bar{\Lambda} + p \to K^{+} + K^{+} + \bar{K}^{-}$ etc.

Some processes are useful for checking these selection rules. (Contractor's abstract)

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

TWO-NEUTRINO HYPOTHESIS AND LEPTON-BARYON SYMMETRY, by C. Iso. [1962] [3]p. (AFOSR-64-0375) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-22 and National Science Foundation) AD 434503 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 456-458, July 16, 1962.

The 2 neutrinos of μ- and β-decays are written as a single 4-component neutrino, $\nu = \begin{matrix}\nu_- \\ \nu_+\end{matrix}$, and the Hamiltonian assumed is $H = \xi J^{+} J$, $J = \bar{e} \gamma_\mu (1 + \gamma_5)\nu + \bar{\nu} \gamma_\mu (1 - \gamma_5)\mu^{+}$ + baryon current. The weak baryon current is supposed to be symmetric under the replacements $\mu^{+} \to \Lambda$, $\nu \to p$, $\bar{e} \to n$, leading to the expression $\bar{n}\gamma_\mu(1 + \gamma_5)p + \bar{\Lambda}\gamma_\mu(1 - \gamma_5)p$. Some consequences are pointed out.

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

CANONICAL ANALYSIS OF GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1962] [10]p. incl. refs. (AFOSR-64-2545) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-22 and National Science Foundation)
AD 453829 Unclassified

Also published in Recent Developments in General Relativity, New York, Pergamon Press, 1962, p. 127-136.

A brief summary of the results of a program isolating the dynamical features of the gravitational field is presented. By analogy with the parametrized form of particle mechanics, the gravitational field Lagrangian is written in first-order form. The constraint equations are solved in principle by decomposing the variables into transverse and longitudinal parts (of which the latter may be discarded) and imposing coordinate conditions. In the end the action integral is written in terms of 4 canonical variables. Different choices of coordinate conditions lead to different canonical variables. The definition of energy and the self-energy problem are discussed. (Math. Rev. abstract, modified)

159

Brandeis U Dept. of Physics, Waltham, Mass.

THE DYNAMICS OF GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1962] [39]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-22 and National Science Foundation) Unclassified

Published in Gravitation: An Introduction to Current Research, ed. by L. Witten. New York, John Wiley & Sons, 1962, p. 227-265.

The problem of the dynamics of the gravitational field is outlined in Section I. Section II presents a brief review of parameterized particle mechanics. The Lagrangian of general relativity is cast into Palantini and 3 + 1 dimensional form, and the geometrical significance of the variables is discussed in Section III. It is shown that relativity has a form identical to parameterized mechanics. Section IV completes the analysis, to obtain the canonical variables and their Poisson bracket relations as well as the P. B. equations of motion. It is possible to set up the analysis of gravitational radiation in a fashion closely analogous to electrodynamics by introducing a suitable definition of the wave zone. In this region, gravitational waves propagate as free radiation, independent of the strong field interior sources. The waves obey ordinary wave equations and consequently satisfy superposition. The Poynting vector may also be defined invariantly in the wave zone. In contrast, the Newtonian-like parts of the metric can not be determined within the wave zone; they depend strongly on the interior non-linearities. These points are discussed in Section V. When the analysis is extended to include coupling of other systems to the gravitational field in Section VI, the above definition of energy may be used to discuss self-energy questions. In this way, the static gravitational and electromagnetic self-masses of point particle systems is treated in Section VII. Whether gravitational effects will maintain the finiteness of self-energies in quantum theory is a question which is considered in the final section.

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

LOW LYING STATES OF A SYSTEM OF INTERACTING BOSONS, by E. P. Gross. [1962] [15]p. (AF AFOSR-61-22) Unclassified

Published in Ann. Phys., v. 20: 44-60, Oct. 1962.

The ground state wave function and energy of a system of interacting bosons is studied. Attention is focused on the real function $S(X_1 \ldots X_N)$ defined by $\Psi = e^S$. S is written as a sum of intrinsic 2-particle, 3-particle, etc. functions. The functions are fully determined by matching intrinsic n-particle terms in the equation obeyed by S. The theory describes both close collisions and the interaction of sets of particles with the surrounding medium. Analysis of the procedure in terms of distribution functions reveals that a linearization of the generalized superposition approximation is the key feature. Excited states of the phonon roton type are found in the form $\Psi = Fe^S$, with F a fully determined sum of terms of different particle numbers. The wave functions are similar to those used by Feynman and Cohen for actual liquid helium, but give a more detailed description of the excitations for the restricted situations where the theory applies. (Contractor's abstract)

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

WEAK INTERACTION MEDIATED BY REGGE PARTICLES, by C. Iso. [1962] [14]p. incl. diagrs. table, refs. (AF AFOSR-61-22) Unclassified

Published in Ann. Phys., v. 23: 304-317, Aug. 1963.

Under the assumption that the weak interaction is mediated by Regge type particles, the cross section for $\nu + n \to p + \bar{\nu}$ is given. This cross section is remarkably different from that given by the usual weak interaction, if the spin of this particle is one and the slope of the Regge trajectory is comparatively as large as for the strongly interacting particles. Finally, a comparison is made between cross sections for weak interactions and strong interactions at high energy when the weak interaction does not have a Regge behavior. (Contractor's abstract, modified)

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Brigham Young U. Dept. of Chemistry, Provo, Utah.

RHENIUM CATALYSTS. IV RHENIUM(III) OXIDE FROM PERRHENATE VIA BOROHYDRIDE REDUCTION, by H. S. Broadbent and J. H. Johnson. [1962] [3]p. incl. table. (AFOSR-64-0921) (AF 18(600)1164) AD 439967 Unclassified

Also published in Jour. Org. Chem., v. 27: 4400-4402, Dec. 1962.

The addition of sodium borohydride to cold aqueous solutions of perrhenate and acetic acid produces good yields of very finely divided, black rhenium (III) oxide possessing marked catalytic activity. A summary of some hydrogenations catalyzed by this substance is presented. The oxide is not ordinarily reduced to lower oxides or the metal during the process of hydrogenation. (Contractor's abstract)

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Brigham Young U. Dept. of Chemistry, Provo, Utah.

RHENIUM CATALYSTS. V. RHENIUM HEPTOXIDE-TETRAHYDROPYRAN COMPLEX, by H. S. Broadbent and J. H. Johnson. [1962] [3]p. incl. table. (AFOSR-64-0922) (AF 18(600)1164) AD 439973 Unclassified

Also published in Jour. Org. Chem., v. 27: 4402-4405, Dec. 1962.

Rhenium (VII) oxide reacts with boiling tetrahydropyran to form a nearly colloidal, black, voluminous, insoluble complex which has unusual activity in catalytic hydrogenations. It is relatively active in promoting saturation of aromatic hydrocarbons whereas nitro compounds are singularly inert under comparable conditions.

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Brigham Young U. Dept. of Chemistry, Provo, Utah.

RHENIUM CATALYSTS. VI. RHENIUM(IV) OXIDE HYDRATE, by H. S. Broadbent and T. G. Selin. [1962] [3]p. incl. table. (AFOSR-64-0923) (AF 18(600)1164) AD 439981 Unclassified

Also published in Jour. Org. Chem., v. 28: 2343-2345, Sept. 1963.

Excess zinc in acid solutions in the presence of air reduces perrhenate to a finely divided black substance characterized as a hydrated rhenium(IV) oxide, probably $ReO_2 \cdot 2.5H_2O$. A survey of its catalytic activity in the hydrogenation of a variety of organic substrates is presented with particular attention to the selectivity of hydrogenation observed.

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Brigham Young U. Dept. of Chemistry, Provo, Utah.

RHENIUM CATALYSTS. VII. RHENIUM(VI) OXIDE, by H. S. Broadbent and W. J. Bartley. [1962] [3]p. incl. table. (AFOSR-64-0924) (AF 18(600)1164) AD 440054 Unclassified

Also published in Jour. Org. Chem., v. 28: 2345-2347, Sept. 1963.

Rhenium(VI) oxide is a very efficient catalyst for the hydrogenation of carboxylic acids and carboxamides, being comparable to the rhenium(VII) oxide which is the most efficient catalyst for these purposes yet reported. The former oxide, which can be very easily and simply made from the latter, is nonhygroscopic and stable in air, thus enjoying considerable advantage in handling over the commercially available higher oxide. (Contractor's abstract)

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Brigham Young U. Dept. of Chemistry, Provo, Utah.

RHENIUM CATALYSTS. VIII. RHENIUM(II) OXIDE DIHYDRATE FROM PERRHENATE VIA ALKALI META-AMINE REDUCTIONS, by H. S. Broadbent and D. W. Seegmiller. [1962] [4]p. incl. tables, refs. (AFOSR-64-0925) (AF 18(600)1164) AD 440055 Unclassified

Also published in Jour. Org. Chem., v. 28: 2347-2350, Sept. 1963.

Ammonium perrhenate and rhenium(VII) oxide (but not potassium perrhenate) are reduced by sodium or lithium (but not potassium) in liquid ammonia or lithium in ethylamine to black, insoluble rhenium(II) oxide dihydrate ($ReO \cdot 2H_2O$), a new compound of rhenium, stable to dehydration at 100° over phosphorus(V) oxide. This rhenium oxide is a catalyst for the hydrogenation of many organic compounds, being particularly efficient for the hydrogenation of the carboxylic acid function. Some interesting examples of selective hydrogenation are reported. (Contractor's abstract)

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

GENERALIZATIONS OF SOME COMBINATORIAL INEQUALITIES OF H. J. RYSER, by M. Marcus and W. R. Gordon. [1962] [11]p (AFOSR-3334) (AF 49-(638)776) Unclassified

Also published in Ill. Jour. Math., v. 7: 582-592, Dec. 1963.

Let H be a non-negative hermitian matrix of rank e and order v with eigenvalues $\lambda_1, \ldots, \lambda_v$, where $\lambda_1 \geq \ldots \geq \lambda_e > \lambda_{e+1} = \ldots = \lambda_v = 0$. Let h be an integer > 1 and such that $e \geq h \geq v$. Define k and λ by

trace (H) = kh, $\lambda_h = k + (h-1)\lambda = \lambda_1$. Let B be the matrix of order h defined by $B = (k-\lambda)I + \lambda J$, where I is the identity matrix and J is the matrix with all entries equal to 1. Let B_0 be the matrix of order v defined by $B_0 = B + 0$, where the sum is direct and 0 is the zero matrix of over v - h. Next, let $k^* = \text{trace}(H)/v$, $\mu = \sum_{i=1}^{v}\sum_{j=1}^{v} h_{ij}$, $\lambda^* = ((\mu/v) - k^*)/(v-1)$ and let B^* be the matrix of order v defined by $B^* = (k^* - \lambda^*)I + \lambda^* J$. By f we understand a non-negative concave symmetric function on v-tuples of non-negative reals. Suppose that whenever $\theta a + (1-\theta)b \in G_f = \{x: f(x) > 0\}$, $0 < \theta < 1$, then

$$f(\theta a + (1-\theta)b) = \theta f(a) + (1-\theta)f(b)$$

if and only if a and b are proportional. Then f is called strictly concave. Let A be a matrix with eigenvalues $\mu_1 \geq 0, \ldots, \mu_v \geq 0$ and let f(A) denote $f(\mu_1, \ldots, \mu_v)$. The main results are the following. If f is concave, then the matrices H and B_0 satisfy $f(H) \geq f(B_0)$. If f is strictly concave and if $(\lambda_1, \ldots, \lambda_v) \in G_f$, then equality holds if and only if H and B_0 have the same eigenvalues [$H = B^*$]. If f is strictly concave, and if for some integer z, G_f is the set of non-negative vectors with at least z positive coordinates and if $k + (h-1)\lambda \neq 0$ and $z \geq h$ or $k + (h-1)\lambda = 0$ and $z < h$ [$z < v$], then $f(H) = f(B_0)$ and only if H and B_0 have the same eigenvalues. Analogous theorems hold for f convex with $f(H) \leq f(B_0)$. The theorems are generalizations d inequalities on compound and induced matrices. The inequalities are combinatorilly significant and may be applied to directed graphs and (v, k, λ) configurations. (Math. Rev. abstract)

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

AN INEQUALITY CONNECTING THE P-CONDITION NUMBER AND THE DETERMINANT, by M. Marcus. [1962] [4]p. (AFOSR-3335) (AF 49(638)776) Unclassified

Also published in Numerische Math., v. 4: 350-353, 1962.

For a positive definite, hermitian matrix A of order n, with characteristic values $\lambda_1 \geq \ldots \geq \lambda_n$, the "P-condition number" is defined to be the ratio $p = \lambda_1/\lambda_n$. The author proves an inequality connecting p, the determinant of the matrix, and the principal diagonal entries a_{ii}, namely,

$$\det A \leq q^{n-1} \prod_{i=1}^{n} a_{ii},$$

where $q = 4p/p(p+1)^2$, and shows that equality occurs if and only if A is a diagonal matrix. The proof depends on the Kantorovich inequality and on some properties of symmetric means. Applications are made to certain special classes of matrices. (Math. Rev. abstract)

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

THE FIELD OF VALUES OF THE HADAMARD PRODUCT, by M. Marcus and R. C. Thompson. [1962] [6]p. (AFOSR-3336) (AF 49(638)776) Unclassified

Also published in Arch. Math., v. 14: 283-288, 1963.

The Hadamard or Schur product A o B of 2 n x n matrices $A = (a_{ik})$, $B = (b_{ik})$ is the matrix $(a_{ik}b_{ik})$. The paper deals (1) with the field of values A o B for A, B normal, in particular if A and B commute. The latter result is applied to A positive definite hermitian and B a scaler function of A, convex, non-increasing on the closed interval determined by the characteristic roots of A. The results of (1) are applied to certain compound matrices and give theorems concerning the location of products of determinants (permanents) of corresponding minors of A and B. The Lyapunov equation $AG + GA^* = K$ is studied. If A is assumed similar to a diagonal then the Lyapunov equation can be trarsformed to $(\alpha_i + \bar{\alpha}_k)g_{ik} = k_j$ which is a Hadamard product. Using this idea a new proof is found for a generalization of Lyapunov's theorem concerning stable matrices. If A is normal then bounds for the characteristic roots of G are also obtained. (Math. Rev. abstract)

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

MATRICES IN LINEAR MECHANICAL SYSTEMS. by M. Marcus. [1962] [5]p. [AF 49(638)776] Unclassified

Published in Canad. Math. Bull., v. 5: 253-257, Sept. 1962.

In a recent paper on the stability of linear mechanical systems S. P. Diliberto discusses certain reduction theorems for symmetric and skew-symmetric Hamiltonian matrices with respect to symplectic orthogonal similarity. In this paper, it is shown that a unified simple argument will handle both of these problems. As an example it is indicated how the argument can also be used to obtain the reduction theorem for symplectic orthogonal matrices. (Contractor's abstract)

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

ASYMPTOTIC VARIATIONAL FORMULAE FOR EIGENVALUES, by C. A. Swanson. [1962] [11]p. (AFOSR-3259) (AF AFOSR-61-89) AD 400839 Unclassified

Also published in Canad. Math. Bull., v. 6: 15-25, Jan. 1963.

The eigenvalues of a second order self-adjoint elliptic differential operator on Riemannian n-space R are considered. The purpose is to obtain asymptotic variational formulae for the eigenvalues under the topological deformations of (1) removing an ϵ-cell (and adjoining an additional boundary condition on the boundary component thereby introduced), and (2) attaching an ϵ-handle, valid on a half-open interval $0 < \epsilon \leq \epsilon_0$. In particular the formulae exhibit the non-analytic nature of the variation. Similar variational problems for singular ordinary differential operators are considered.

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

ASYMPTOTIC ESTIMATES FOR LIMIT CIRCLE PROBLEMS, by C. A. Swanson. [1961] [11]p. incl. refs. [AF AFOSR-61-89] Unclassified

Published in Pacific Jour. Math., v. 11: 1549-1559, Winter 1961.

Characteristic-value problems are considered for the second-order differential operator L defined by (1) $Lx = 1/k(s)\{-d/ds[p(s)dx/ds] + q(s)x\}$ on the open interval $-\infty \leq \omega- < s < \omega+ \leq \infty$, with suitable boundary conditions at $\omega-$, $\omega+$ $\omega-$, $\omega+$ are, in general, singularities of L. The type of result desired is to begin with a regular Sturm-Liouville problem. (2) $Ly = \mu y$, $U_a y = U_b y = 0$, on the closed bounded interval $[a, b] \subset (\omega-, \omega+)$, and obtain estimates which imply that for each characteristic value $\mu = \mu_{ab}$ of (2), the limits of μ_{ab} as a, $b \to \omega-, \omega+$ will exist. Here U_a, U_b are appropriate boundary operators. The estimates are obtained by means of projection mappings on suitable Hilbert spaces. The basic assumption in this paper is that both is that both $\omega-$, $\omega+$ are limit-circle singularities of L. Then estimates are given which imply that for each characteristic value λ of (1), there exists a characteristic value μ_{ab} of (2) near λ for a, b near $\omega-, \omega+$ and $\mu_{ab} \to \lambda$ as a, $b \to \omega-, \omega+$, under suitable restrictions as to the limiting behavior of $U_a x$, $U_b x$ as a, $b \to \omega-, \omega+$. Estimates are also given comparing characteristic functions of (1) and (2). (Math. Rev. abstract, modified)

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

APPROXIMATION PROPERTIES OF MEASURES GENERATED BY CONTINUOUS SET FUNCTIONS, by M. Sion and D. Sjerve. [1962] [12]p. (AFOSR-J475) (AF AFOSR-62-261) AD 407109 Unclassified

Also published in Mathematica, v. 9: 145-156, 1962.

The authors consider a wide class of Caratheodory outer measures $\mu_\sigma(\tau)$ and $\mu(\tau) = \lim_{\sigma \to 0} \mu_\sigma(\tau)$ defined in terms of a set function τ on the class of all subsets of a compact metric space X. The Hausdorff measures correspond to the special τ of the form $\tau(A) = h(\text{diam } A)$. The paper also reviews, unifies, and simplifies a large body of known results. (Math. Rev. abstract, modified)

174

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

ON COVERING SYSTEMS, by D. J. Mallory and M. Sion. [1962] [10]p. (AFOSR-64-0670) (AF AFOSR-62-261) AD 436279 Unclassified

Also published in Canad. Jour. Math., v. 16: 18-27, 1964.

The relationships between 3 systems are studied: (1) Vitali systems (V-systems); (2) a modification of the systems having the property (V) introduced by Sion (S-systems); and (3) a modification of the tile systems studied in Hahn and Rosenthal (T-systems). The main results state that V-systems are always S-systems; under certain conditions, V-systems are T-systems under more stringent conditions, S-systems are T-systems. It is then shown that the converses, in general, do not hold. It is also shown that for T-systems, measurable functions are approximately continuous. This result is applied to obtain a density theorem.

175

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

ON HAUSDORFF MEASURES IN TOPOLOGICAL SPACES, by C. A. Rogers and M. Sion. [1962] [10]p. (AFOSR-64-1626) (AF AFOSR-62-261) AD 446891 Unclassified

Also published in Monatsh. Math., v. 67: 269-278, 1963.

A generalized process is introduced for defining measures in a topological space. The sets which are measurable for these measures are studied. Some approximation properties are established. It is shown that, when the space X is metric, the new measures are closely related to those defined in the usual way, by use of coverings by sets of small diameter. Some non-trivial examples of measures, constructed by the process are also given.

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

ABEL-PERRON INTEGRALS, by P. S. Bullen. [1962] [3]p. (AF AFOSR-62-261) Unclassified

Consider the class of L-harmonic functions h, defined in R^n, $n \geq 2$, by the elliptic operator L, $h = 0$ where

$$(1)\quad L\,h = \sum_{i,\,j=1}^{n} a_{ij}\frac{\partial^2 h}{\partial x_i \partial x_j} + \sum_{i=1}^{n} b_i \frac{\partial h}{\partial x_i} + c\,h$$

Many of the concepts of classical potential theory extend to this class. Generalizations of L have been developed by several authors. Using their results it is hoped to extend Rudin's classical results to cover all L in (1).

177

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

CONSTRUCTION OF ORLIEZ SPACES BY COMPLETION By P. S. Bullen. [1962] [8]p. (AF AFOSR-62-261) Unclassified

Zamansky has shown how to construct the L_ρ spaces by completion. In this report, the same construction is carried out for the Orliez spaces L_ϕ. This construction uses Zamansky's as an example but has the advantage of avoiding the separate discussion of the cases $\rho = 1$ and $\rho > 1$ required by Zamansky.

178

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

EFFICIENCY OF PREDICTOR-CORRECTOR PROCEDURES. by T. E. Hull and A. L. Creemer. [1962] [11]p. incl. diagrs. (AFOSR-J1210) (In cooperation with New York U., N. Y.) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-264 and Defence Research Board of Canada) AD 424171 Unclassified

Also published in Jour. Assoc. Comput. Mach., v. 10: 291-301, July 1963.

This is a study of numerical solution of first-order differential equations by predictor-corrector methods. The study is restricted to methods of the Adams type. Some 17 different differential equations with know analytic solutions were solved on a digital computer. These were done with various step sizes, various predictor-corrector formulas, and with various numbers of iterations of the corrector per step. Several plots of error vs cost (number of evaluations of the differential equation) are shown. It appears that the best predictor-corrector procedures, at least for general purposes, assuming f is fairly complicated, are those which involve 2 evaluations of f and 2 applications of the corrector formula per step. No comparison is made with Runge-Kutta type formulas. (Math. Rev. abstract)

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

MIXED CONGRUENTIAL RANDOM GENERATORS FOR DECIMAL MACHINES, by J. L. Allard, A. R. Dobell and T. E. Hull. [1962] [11]p. incl. tables, refs. [AF AFOSR-62-264] Unclassified

Published in Jour. Assoc. Comput. Mach., v. 10: 131-141, Apr. 1963.

This paper summarizes the results of extensive testing of random number generators of the mixed congruential type. Most results are for word length 10, and special attention is given to simple multipliers which give fast generators. Results show that these mixed generators, in contrast to the multiplicative ones, are not consistently good from a statistical point of view. The cases which are bad seem to belong to a well-defined class which, unfortunately, includes most of the generators associated with the simple multipliers. However, an unexpected result is that all generators associated with one of the simplest and fastest multipliers, namely 101, turn out to be consistently good for word lengths greater than 7 digits. A final section of the paper suggests a simple theoretical explanation of these experimental results. (Contractor's abstract, modified)

180

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

STABILITY IN THE NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS, by T. E. Hull. [1962] [2]p. [AF AFOSR-62-264] Unclassified

Published in Information Processing; Proc. of the Internat'l. Federation for Information Processing Congress, Munich (Germany) (Aug. 27-Sept. 1, 1962). Amsterdam, North-Holland Publishing Co., 1963. p. 211-212.

The purpose of this paper is to consider the stability of predictor-corrector procedures in the numerical integration of the initial value problem for ordinary differential equations. First, a consistent corrector formula is defined as one whose local truncation error is $O(h^2)$ as $h \to 0$. Then, the result, is as follows: the approximate solution generated by a predictor-corrector procedure will converge to the solution of the initial-value problem as $h \to 0$ if and only if the corrector formula is both consistent and stable; moreover, a necessary and sufficient condition for stability is that the zeros of $S^k - \sum a_i S^{k-i}$ are in or on the unit circle, and that if they are on it they are simple. In the second part of this work, h is considered to be small but not equal to zero. The number of iterations is considered to be large (in practice 3 or 4) so that the effect of the predictor formula is negligible. In the third and final section of the paper, the problem is reduced to choosing the step number, the number of iterations per step, and the step-size.

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

ULTRASONIC ATTENUATION IN SUPERCONDUCTORS: ANISOTROPY OF THE ENERGY GAP (Abstract), by J. R. Leibowitz and R. W. Morse. [1962] [1]p. [AF 49(638)6] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 63, Jan. 24, 1962.

Anisotropy in the superconducting energy gap, observed by means of transverse ultrasonic waves, is reported. On the free-electron model, transverse lattive waves interact more selectively with electrons on the Fermi surface than do longitudinal waves, and hence probe the gap anisotropy more finely. The temperature dependence of superconducting attenuation $\alpha_s(T)$ was measured as a function of orientation in single crystal tin, at frequencies up to 70 m c/sec for all principal propagation directions and all polarization directions permitted by summetry. Amsotropy was found to be associated with change of polarization as well as propagation direction. For all orientations, in addition, $\alpha_s \propto \exp$ was found, within experimental accuracy, to be of exponential form at low reduced temperature as predicted by BCS. Certain features of the anisotropy in apparent energy gap found to be associated with rotation of polarization vector in the (001) plane (the range of gap values being 3.4 to 4.3 kT_c) are believed to be of special interest. Difficulties associated with "real metals effects" are discussed, and some qualitative identifications with Fermi surface structure are treated.

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

AN EXPERIMENTAL METHOD FOR MEASURING THE ELECTRICAL CONDUCTIVITY OF HIGH TEMPERATURE GASES, by G. F. Anderson. June 1962 [53]p. incl. illus. diagrs. tables, refs. (Technical rept. no. AT-35) (AFOSR-3027) (AF AFOSR-62-111) AD 281876 Unclassified

Also published in part in Jour. Aerospace Sci., v. 29: 1263-1264, Oct. 1962

The feasibility of utilizing the effect of a conducting medium on the impedance of a small coil for the measurement gases is investigated theoretically and experimentally. The method described is well suited for measuring the electrical conductivity of gases at high densities. Data which have been obtained for air in the range of 5 mhos meter to 250 mhos meter at atmospheric density are included to illustrate the use and feasibility of the experimental technique. (Contractor's abstract)

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

SOME ASPECTS OF GRAIN BOUNDARY MIGRATION IN PLASTICALLY DEFORMED SINGLE CRYSTALS, by B. K. Basu and C. Elbaum. May 1962 [19]p. incl. illus. diagrs. (AFOSR-2643) (AF 49(638)479) AD 286320 Unclassified

The migration of various grain boundaries is studied in Al specimens; these specimens are prepared from single crystals, deformed plastically at room temperature. Boundary velocities are measured (for a given temperature) as a function of boundary rotation and position parameters. Dislocation densities and arrangements are determined in the recrystallized volume of the specimen, by means of an x-ray diffraction technique suitable for this purpose. Large differences have been found in the mobility of grain boundaries, as a function of boundary position (tilt or twist), for a given rotation angle. Correlations between boundary angle and dislocation density in the recrystallized volume are discussed. The passage of certain grain boundaries was found to produce crystals of unusually low dislocation density and very uniform reflecting power for x-rays. Crystals of comparable perfection are frequently encountered in some ionic and covalent solids, but are quite unusual in Al. (Contractor's abstract)

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

EFFECT OF THERMAL FLUCTUATIONS ON STRAIN-AMPLITUDE-DEPENDENT DAMPING (Abstract), by L. J. Teutonico, A. V. Granato, and K. Lücke. [1962] [1]p. Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)479], Army Ordnance Office, and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 223, Mar. 26, 1962.

Although the mechanical theory of Granato and Lücke for the strain-amplitude-dependent internal friction and modulus changes of solids containing dislocations gives a fair account of many of the observed effects, simple theoretical calculations show that the effect of thermal fluctuations should be very important. To extend the theory to finite temperatures, a detailed study of the possible static-equilibrium configurations of a pinned dislocation as a function of external stress is required. Results are presented for the 2 specific examples of a dislocation with a single pinning point and a continuously pinned dislocation. By considering the kinetics of breakaway, it is shown how the decrement and modulus change can be computed from these results. A qualitative discussion of expected behavior is given.

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

JUMP FREQUENCY OF A PINNED DISLOCATION SEGMENT (Abstract), by A. V. Granato, K. Lücke, and L. [J.] Teutonico. [1962] [1]p. [Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)479, Army Ordnance Office, and Atomic Energy Commission] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 223-224, Mar. 26, 1962.

The mean time τ required for a pinned dislocation segment to jump away from a pinning point by thermal fluctuations is given by rate theory in the form $\tau^{-1} = \nu_0 \exp(\Delta S/K) \exp(-\Delta U/KT)$, where the symbols have their conventional meanings. A calculation has been made of the effective jump frequency, or the product of the attack frequency ν_0 and the entropy factor $\exp(\Delta S/K)$. This quantity is required in theories of internal friction, creep, and flow stress. Under the assumption that the normal modes of a crystal containing dislocations can be split into the usual Debye waves plus localized modes at the dislocations, the frequencies of the dislocation modes can be computed for both the stable pinned position and the saddle-point position by using the vibrating-string analogy for the dislocation. From these, the attack frequency is found using Vineyard's analysis. The result is that the attack frequency depends only on the pinning-point interaction energy ΔU and not on the length of the dislocation segment, in spite of the fact that ν_0 depends on the dislocation length. For $\Delta U = 0.1$ ev, the jump frequency is of the order 10^{10} sec^{-1}.

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

NOTE ON SECOND-ORDER W. K. B. PHASE SHIFTS, by S.-I. Choi and J. Ross. [1962] [4]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)87, Alfred P. Sloan Foundation, and National Science Foundation) Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 48: 803-806, May 1962.

The phase shifts for elastic scattering by a spherical potential are obtained by the WKB approximation of the radial wave function up to second-order terms. The difficulties of applying the approximation to the radial Schrodinger equation can be overcome by a transformation as pointed out by Langer. Inspection of the transformation equation suggests that the solution is the same as the normal equation with the substitution of $(l + \frac{1}{2})^2$ for $l(l + 1)$. This was borne out by the calculation of the first order terms. The paper derives the second order WKB phase shifts of the elastic scattering from the transformed radial equation and shows that this simple substitution in the second order solution of the normal equation no longer gives the correct solution. The phase shifts in the 2 cases are tabulated for the Lennard-Jones potential.

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Budd Co., Inc. [Budd Electronics Div.] Long Island City, N. Y.

AUTOMATIC RECOGNITION TECHNIQUES APPLICABLE TO HIGH-INFORMATION PICTORIAL INPUTS, by A. Rosenfeld. [1962; [10]p. incl illus. tables. [AF 49(638)1143] Unclassified

Presented at 1962 I. R. E. Internat'l. Convention, New York, Mar. 26-29, 1962

Abstract published in Proc. Inst. Radio Engineers, v. 50: 351, Mar. 1962.

Published in I. R. E. Internat'l. Convention Record, Pt. 4: 114-123, 1962.

This paper describes an automatic recognition technique which is applicable to high-information-content inputs such as antenna or space reconnaissance data. The basic steps involved are: (1) Measurement of data texture (average amplitude and contrast frequency spectrum); (2) Extraction of conspicuous figures, formed by outstanding contrast discontinuities or radical texture changes; (3) Recognition of certain simple straight line figures, such as parallels and perpendiculars; (4) Analysis of the context in which various combinations of textures and figures occur. Applications and instrumentation possibilities are considered. (Contractor's abstract)

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Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

THE EXTRACELLULAR SPACE IN THE TOAD RETINA AS DEFINED BY THE DISTRIBUTION OF FERROCYANIDE. A LIGHT AND ELECTRON MICROSCOPE STUDY, by A. Lasansky and F. Wald. [1962] [17]p. incl. illus. refs. (AFOSR-J1050) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-60-5 and Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina) Unclassified

Also published in Jour. Cell. Biol., v. 15: 473-479, Dec. 1962.

Measurements of the uptake of compounds that ordinarily do not penetrate into cells have been a source of data on the size of the extracellular space in nervous tissue. The distribution of one such compound, ferrocyanide, has been studied in the toad retina by means of the light and electron microscopes. At the level of the light microscope, ferrocyanide, detected as

Prussian blue, appears to penetrate predominately within the inner processes of Müller cells. A diffuse background staining by Prussian blue can be noticed also at the inner retinal layers. At the level of the electron microscope, Müller cells exhibit an extensively developed system of channels which are formed by infoldings of the plasma membrane. Ferrocyanide, detected as copper ferrocyanide deposits, is found occupying the lumina of these channels and in the narrow intercellular gaps of the retina. These observations indicate that in the toad retina the extracellular medium includes the intercellular spaces plus a glial compartment formed by the infoldings of the plasma membrane of the Müller cells. (Contractor's abstract)

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Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

MITOCHONDRIOGENESIS IN NERVE FIBERS OF THE INFRARED RECEPTOR MEMBRANE OF PIT VIPERS; by E. De Robertis and H. Bleichmar. [1962] [11]p. incl. illus. diagr. refs. (APOSR-J1173) (AF AFOSR-61-40) AD 424259 Unclassified

Also published in Zeitschr. Zellforsch. und Microskop. Anat., v. 57: 572-582, 1962.

The myelinated nerve fibers that innervate the infrared receptor membrane of pit vipers were studied under the electronmicroscope. Along the course of the fiber, toward the nerve terminal, segments of the axon with an increasing concentration of mitochondria were found, and a special region was recognized where an active process of mitochondriogenesis seems to occur. In these regions the axon has varying amounts of mitochondria, is devoid of neuroprotofibrils, and the axoplasmic matrix is dense and contains numerous membranes, some of which can be traced as infoldings of the axolemma. The images observed have led to a tentative postulation of a mechanism of mitochondrial formation, which would start with the infolding of the axolemma, would continue with the curving of 2 parallel membranes around a denser portion of axoplasmic matrix, the development of inner crests, and the final closing of the membrane. The possible electrochemical properties of mitochondrial membranes deriving from an excitable membrane are discussed in relation to the special receptive properties of these nerve fibers.

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Buffalo U. Dept. of Chemistry, N. Y.

DIELECTRIC CONSTANT OF HYDROGEN-BONDED LIQUIDS. I. CYANOACETYLENE, by W. Danhauser and A. F. Flueckinger. Aug. 1962, 4p. incl. diagrs. tables, refs. (AFOSR-J241) (AF 49(638)939) AD 400869 Unclassified

Also published in Jour. Chem. Phys., v. 38: 69-72, Jan. 1, 1963.

The dielectric constant of cyanoacetylene was determined over the normal liquid range: $\epsilon(T)$ = (71000/T) -170. Analysis of the data in terms of a hydrogen-bonded linear polymer yields: ΔH = 2.80 kcal; ΔS = 15.8 eu/mol of hydrogen bond. The vapor pressure of solid and liquid HCCCN was measured. Molar enthalpies and entropies of fusion and vaporization are: 3.38 and 6.72 kcal; 12.1 and 21.3 eu, respectively. Hydrogen bonding in this and similar a[illegible] is discussed. (Contractor's abstract)

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Bureau of Mines, Bartlesville, Okla.

4-FLUOROTOLUENE: CHEMICAL THERMODYNAMIC PROPERTIES, VIBRATIONAL ASSIGNMENT, AND INTERNAL ROTATION, by D. W. Scott, J. F. Messerly and others. [1962] [7]p. incl. tables, refs. (AFOSR-5040) (CSO-680-57-4) AD 456557 Unclassified

Also published in Jour. Chem. Phys., v. 37: 867-873, Aug. 15, 1962.

Thermodynamic data were obtained for 4-fluorotoluene and correlated by methods of statistical mechanics to derive values of the chemical thermodynamic properties in the ideal-gas state from 0° to 1500°K. A vibrational assignment consistent with the calorimetric data was obtained. Integral rotation was shown to be essentially free. Experimental studies provided the following information: values of heat capacity for the solid (13°K to the triple point), the liquid (triple point to 361°K), and the vapor (377° to 500°K); the triple-point temperature; the heat of fusion; thermodynamic functions for the solid and liquid (0° to 390°K); heat of vaporization (347° to 390°K); parameters of the equation of state; and vapor pressure (341° to 428°K). (Contractor's abstract)

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Bureau of Mines, Bartlesville, Okla.

COMBUSTION CALORIMETRY OF ORGANIC FLUORINE COMPOUNDS. THE HEATS OF COMBUSTION AND FORMATION OF THE DIFLUOROBENZENES, 4-FLUOROTOLUENE AND m-TRIFLUOROTOLUIC ACID, by W. D. Good, J. L. Lacina and others. [1962] [4]p. incl. tables. (AFOSR-J56. (CSO-680-57-4) AD 400393 Unclassified

Also published in Jour. Phys. Chem., v. 66: 1529-1532, Aug. 1962.

The heats of combustion of 5 aromatic fluorine compounds were determined by a rotating-bomb method of combustion calorimetry. The suitability of m-trifluorotoluic acid (o-, m-, p-trifluoromethylbenzoic acid) as a reference substance for the combustion calorimetry of organic fluorine compounds was investigated. The following values, in kcal mol^{-1}, are reported for the standard heats of formation, $\Delta Hf^{o}_{298.15}$ from graphite and gaseous hydrogen, oxygen, and fluorine: 4-fluorotoluene(g), -34.01; 1,2-difluorobenzene(g), -67.65; 1,3-difluorobenzene(g), -71.35, 1,4-difluorobenzene(g), -70.69, and m-trifluorotoluic acid(c), -251.78.

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Bureau of Mines, Bartlesville, Okla.

1,2-DIFLUOROBENZENE: CHEMICAL THERMODYNAMIC PROPERTIES AND VIBRATIONAL ASSIGNMENT, by D. W. Scott, J. F. Messerly and others. [1962] [8]p. incl. tables, refs. (Contribution no. 120) (APOSR-J670) (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under [CSO-680-57-4]) AD 413631
Unclassified

Also published in Jour. Chem. Phys., v. 36: 532-539, Jan. 15, 1962.

Thermodynamic data were obtained for 1,2-difluorobenzene and correlated by methods of statistical mechanics to derive values of the chemical thermodynamic properties in the ideal-gas state from 0° to 1500°K. A vibrational assignment consistent with the calorimetric data was obtained. The experimental studies provided the following information: values of heat capacity for the solid (14°K to the triple point), the liquid (triple point to 357°K), and the vapor (355° to 500°K); the triple-point temperature; the heat of fusion, thermodynamic functions for the solid and liquid (0° to 370°K); heat of vaporization (327° to 367°K); parameters of the equation of state; and vapor pressure (304° to 403°K).

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Bureau of Mines, Bartlesville, Okla.

PERFLUOROPIPERIDINE: ENTHOPY, HEAT OF FORMATION, AND VAPOR PRESSURE; N-F BOND ENERGY; AND SOLID STATE TRANSITIONS, by W. D. Good, J. S. Todd and others. [1957] [6]p. incl. diagrs. tables, refs. (Contribution no. 118) (APOSR-J832) (CSO-680-57-4) AD 416502 Unclassified

Presented in part at meeting of the Amer. Chem. Soc., Tulsa, Okla., Dec. 4-6, 1957.

Presented in part at 133rd meeting of the Amer. Chem. Soc., San Francisco, Calif., Apr. 13-18, 1958.

Also published in Jour. Phys. Chem., v. 67: 1306-1311, June 1963.

Measurements were made of the thermodynamic properties of perfluoropiperidine, $C_5F_{11}N$. The experimental studies provided the following: values of heat capacity for the solid above 12°K and the liquid below 320°K; temperature of 2 transitions in the solid state; triple-point temperature; heats of transition, fusion, and vaporization; vapor pressure (302° - 355°K); and the standard heats of combustion and formation at 298.15°K. A value for the N-F thermochemical bond energy was calculated from the results.

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Bureau of Mines, Bartlesville, Okla.

1,2-BIS-DIFLUOROAMINO-4-METHYLPENTANE: HEATS OF COMBUSTION, FORMATION, AND VAPORIZATION; AND VAPOR PRESSURE, by W. D. Good, D. R. Douslin, and J. P. McCullough. [1962] [12]p. (Contribution no. 116) (APOSR-2188) (CSO-680-59-9) AD 272396 Unclassified

Also published in Jour. Phys. Chem., v. 66: 958-959, May 1962.

Accurate thermodynamic data were determined for 1,2-bis-difluoroamino-4-methylpentane. The heat of combustion and vapor pressure were measured and the standard heats of formation and vaporization were calculated from the observed data.

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Bureau of Mines, Bartlesville, Okla.

AN INCLINED-PISTON DEAD-WEIGHT PRESSURE GAUGE, by D. R. Douslin, J. Toalson and others. Feb. 1962 [20]p. incl. diagrs. table, refs. (Contribution no. 114) (APOSR-2189) (Sponsored jointly by Air Force Office of Scientific Research under CSO-680-59-5 and American Petroleum Inst.) AD 272397
Unclassified

An inclined-piston gauge for accurate vapor-pressure measurements in the range 0.1 to 40 mm was designed and constructed. The gauge operates on the dead-weight principle from a zero pressure datum level. The test measurements on ice and water demonstrate the excellent possibilities the inclined-piston gauge offers as an instrument for very precise and accurate vapor pressure work in the low and intermediate pressure range. Present applications include determining vapor pressures below room temperature for high boiling or unstable organic substances that cannot be studied by other static or ebulliometric methods and for detonable or rare substances which require the use of small samples. From the results, accurate values of the heat and entropy of vaporization and entropy of compression can be calculated. (Contractor's abstract)

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Bureau of Mines, Bartlesville, Okla.

1,2-BIS-DIFLUOROAMINO-4-METHYLPENTANE: HEATS OF COMBUSTION FORMATION, AND VAPORIZATION; VAPOR PRESSURE; AND N-F THERMOCHEMICAL BOND ENERGY, by W. D. Good, D. R. Douslin, and J. P. McCullough. [1962] [3]p. incl. diagrs. tables, refs. (Contribution no. 119) (APOSR-J904) (CSO-680-59-9) AD 415992 Unclassified

Also published in Jour. Phys. Chem., v. 67: 1312-1314, June 1963.

The heat of combustion of 1,2-bis-difluoroamino-4-methylpentane was measured by rotating-bomb

calorimetry, and the vapor pressure was measured between -20° and +20° with an inclined-piston gauge. Experimental techniques suitable for studying compounds of this class were developed. The results were used to calculate the following thermochemical data in kcal mol^{-1} at 298.15°K: standard heat of formation of the liquid, -60.09; heat of vaporization, 10.51; and standard heat of formation of the gas, -49.58. The N-F thermochemical bond energy in this compound was found to be 67 kcal mol^{-1}, about the same as the N-F thermochemical bond energy in NF_3 and N_2F_4 but significantly less than that in perfluoropiperidine. (Contractor's abstract)

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Bureau of Mines, Pittsburgh, Pa.

STRUCTURE AND PROPAGATION OF TURBULENT BUNSEN FLAMES, by D. Burgess. [1961] 42p. incl. illus. diagrs. tables, refs. (Bull. no. 604) (AFOSR-4405) (CSO-680-58-10) Unclassified

This report presents the results of several experiments which were performed in order to elucidate the problem of turbulent flames. Included are measurements of v' in flames by helium diffusion, electronic probe, and by Toepler photographs; measurements of gas flow patterns by particle track and pitot tube mapping; measurements of reactant and product concentration profiles; spectrographic studies aimed at specifying a reaction path; photographic observations; and many measurements of turbulent burning velocity. From the viewpoint of this report, the important advances lie (1) in a delineation of experimental conditions under which the wrinkled flame is real, (2) in accumulating evidence that the scale of turbulence, or at least the burner dimension, is of importance, and (3) in the recognition of such factors as the core-mixing zone distinction which have caused unfavorable comparisons of burning velocity data in the past.

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Bureau of Social Science Research, Inc., Washington, D. C.

ON SOME DIFFERENCES IN MODES OF RESEARCH AMONG PSYCHOLOGISTS AND SOCIOLOGISTS, by S. Z. Klausner. [1962] [27]p. incl. tables, refs. (AFOSR-65-0976) (AF 49(638)992) AD 619628 Unclassified

Also published in Trans. of the Fifth World Congress of Sociology, Washington, D. C. (Sept. 2-8, 1962), Louvain (Belgium), Internatl. Sociological Assoc., v. 4: 209-235, 1964.

Studies were made of the differences and similarities in research methods of sociologists and psychologists by comparing research done in the field of religion by 2 sample groups of the 2 professions. Comparisons were made of the system levels with which the research was concerned, the methods of gathering data, the technical terminology used by each, the type of value judgments made, and the modes of inference used. Results indicate that sociologists tend to prefer face-to-face interview methods, to designate their concepts with non-technical terms, to be either neutral or positive in evaluating the behavior they observe, and to think in classificatory and descriptive terms. Psychologists prefer more standardized questionnaire methods of data gathering, use technical terms to designate concepts, are concerned with the negative side of their objects of study, and think in terms of inductive generalizations. These methodological differences no doubt condition whatever substantive differences exist between the fields

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California Academy of Sciences, San Francisco.

DOES THE BOBOLINK NAVIGATE. by W. J. Hamilton, III. [1962] [11]p. (AFOSR-2517) (AF 49(638)825; AD 611342 Unclassified

Also published in Wilson Bull., v. 74: 357-366, Dec. 31, 1962.

On Sept. 1, 1959, a captive adult female Bobolink escaped from captivity a Berkeley, California. This bird had been taken from its breeding locality in North Dakota on Aug. 9, 1959 and shipped to Berkeley where it was held on a light-dark schedule coinciding with the natural photoperiod for its home locality in North Dakota. On the 3 nights prior to escape this bird was held in an experimental cage automatically registering the directional component of migratory activity at night. On the first of these nights the preferred direction almost coincided with the home direction, while on the third the direction was parallel to the natural route of migration of the population from which this bird was derived. The direction on the second night was intermediate. On the first day of June of the following year this same bird was recaptured at the location where it was originally trapped in Kenmare, North Dakota. Since the experimental site in California is not on a migratory pathway of Bobolinks, some navigation capacity permitting the eventual return seems to be implied. The orientation mechanism and the possible travels of this bird prior to recapture are discussed.

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California Academy of Sciences, San Francisco.

EVIDENCE CONCERNING THE FUNCTION OF NOCTURNAL CALL NOTES OF MIGRATORY BIRDS, by W. J. Hamilton, III. [1962] [12]p. incl. diagrs. table, refs. (AFOSR-2518) (AF 49(638)825; AD 299695 Unclassified

Also published in Condor, v. 64: 390-401, Sept. 1962.

Many species of birds migrating at night have characteristic call notes. Species which regularly form flocks during the day have a night migration note apparently indistinguishable from the daytime call note. Other species seem to have a night note so different from the day note that it is often difficult to identify the caller. The most intensive night restlessness of captive caged Bobolinks is reflected by fluttering. Associated with this fluttering is a call note which is apparently the same as the call of migrants. If this call is recorded and played back to caged birds it amplifies the response of birds already showing migratory restlessness and may induce weakly responding birds to greater responsiveness. Birds which have not been responding regularly, and may thus be assumed not to be in physiological migratory condition, usually ignore the stimulus. With the input of additional calls to strongly responding birds, the response is often to fly up even though the bird has previously learned that such action will result in crashing into the lid of the apparatus. The suggestion is made that this behavior, extended to natural migration, may mean that the calls of migrants aloft induce grounded birds to fly up. This suggestion is in part supported by observations and analysis of the temporal pattern of migration. Some species of passerines and some nonpasserines seem to maintain flocks during night migration. These flocks are very open in comparison with flocks of birds noted during daylight and it is suggested that for many species contact is maintained largely by the call note. The night flocks of passerines are often composed of mixed species. Possible ways in which the call notes may serve to provide sufficient orienting cues for flock maintenance are discussed. While the sonagraph analysis shows that each note has characteristics that may enhance its location, more effective corrections for direction would be possible by either hearing the same individual a second time or by using the calls from a flock. Consistent individual differences in structure of notes suggest the feasibility of corrections based on hearing subsequent notes from the same individual.

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California Academy of Sciences, San Francisco.

BOBOLINK MIGRATORY PATHWAYS AND THEIR EXPERIMENTAL ANALYSIS UNDER NIGHT SKIES, by W. J. Hamilton, III. [1962] [26]p. incl. illus. diagrs. refs. (AFOSR-2519) (AF 49(638)825) AD 400051 Unclassified

Also published in The Auk, v. 79: 208-233, Apr. 1962.

By observing or recording automatically the facing direction or the restricted locomotion of a Bobolink confined to an experimental apparatus, the orientation of migratory behavior was analyzed. Birds were largely from a North Dakota breeding population. The experiments were all done in and around San Francisco, California, with the birds held on local San Francisco time either in indoor cages or under the natural sky. A consideration of the course taken by geographically displaced birds suggests that the preferred migration direction depends upon a shifted timing mechanism. Spring-migration trends to the north have so far been obtained only for a population of birds taken in migration in Florida. The responses of these Florida birds showed wide scatter contrasting with the comparatively homogeneous result obtained from the North Dakota population. Experiments indicate that the Bobolink is capable of telling direction by some feature of the clear night sky. Both immature and adult birds are capable of making such directional determinations. The directional choice is probably based on the stars and the internal clock. The clock apparently does not compensate for the advance of the sidereal day in relation to the solar day. Each population of Bobolinks throughout the breeding area may have a unique preferred migration direction, at least until the migration becomes a common pathway in the southeastern United States. While the stars are obviously important to directional choices at night, other orienting cues such as terrain features and other birds of the same species, and perhaps other species in flight at the same time, may provide additional information upon which the directional course is based.

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California Inst. of Tech., Pasadena.

STRUCTURE OF LIQUIDS, by C. J. Pings. Final rept. Mar. 23, 1962 [62]p. incl. diagrs. table, refs. (AFOSR-2423) (AF 49(638)800) Unclassified

Equipmental techniques were developed for the measurement of the x-ray diffraction pattern from pressurized liquids. Initial studies on liquid nitrogen at -193°C and 7 atm have been analyzed and indicate a first order coordination shell of 15 nearest neighbor nitrogen molecules at a distance of 4A. Prior suggestions of the existence of an N_4 molecule have been shown to be unreliable. Apparatus was designed and constructed for the measurement of refractive index of solids and liquids under conditions of controlled temperature and pressure. The device is currently being used for studies of refractive index of solid and liquid argon. Both the x-ray diffraction and refractive index studies are continuing. (Contractor's abstract)

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California Inst. of Tech., Pasadena.

STRUCTURE OF LIQUID NITROGEN, by C. J. Pings. [1962] [11]p. incl. diagr. (AFOSR-J4) (Bound with its AFOSR-2423, as appendix C) (In cooperation with Stanford U., Calif.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)800], National Science Foundation, Office of Naval Research, and Research Corporation) AD 400074 Unclassified

Also published in Molec. Phys., v. 5: 531-534, Sept. 1962.

The experimentally determined electronic radial distribution function for liquid nitrogen at 7 atm and -193°C is reported, indicating an average coordination shell centered at 4.0A containing 15 molecules. Subsidiary peaks in the distribution at about 2.2A are shown to very likely arise from truncation of the Fourier integral. Analysis reveals that a restricted increase in the range of diffraction data may actually increase the prominence of certain error features. (Contractor's abstract)

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California Inst. of Tech., Pasadena.

CELL FOR X-RAY DIFFRACTION STUDIES OF ABSORBING LIQUIDS, by S. E. Rodriguez and C. J. Pings. [1962] [2]p. incl. diagrs. (AFOSR-J238) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-141 and Office of Naval Research) AD 408972 Unclassified

Also published in Rev. Scient. Instr., v. 33: 1469-1470, Dec. 1962.

X-ray diffraction measurements on highly absorbing liquids are often carried out by a reflection method in which scattered intensity is measured on the same side of the liquid surface as the incident beam. An experimental design for such measurements using a horizontal-axis diffractometer is described. (Contractor's abstract)

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California Inst. of Tech., Pasadena.

OPTICAL DETERMINATION OF THE COMPRESSIBILITY OF SOLID ARGON, by B. L. Smith and C. J. Pings. [1962] [3]p. incl. diagrs. table, refs. (AFOSR-J289) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-141] and Office of Naval Research) Unclassified

Also published in Jour. Chem. Phys., v. 38: 825-827, Feb. 15, 1963.

The compressibility of solid argon was measured in the temperature range 78° to 94°K by a new optical method. A value for the coefficient of thermal expansion was also obtained. The results are

$k_T = (6.65 \pm 0.19) \times 10^{-11}$ cm^2 dyn^{-1} at 78°K and

$\beta = (1.95 \pm 0.07) \times 10^{-3}$ (°K)$^{-1}$ at 81°K. The experimental method is discussed and the results compared with existing experimental data. (Contractor's abstract)

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California Inst. of Tech., Pasadena

OPTICAL CELL FOR PRESSURIZED SOLIDS AND LIQUIDS AT CRYOGENIC TEMPERATURES, by B. L. Smith. July 1962, 3p. incl. diagrs. refs. (AFOSR-J290) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-141] and National Science Foundation) AD 408018 Unclassified

Also published in Rev. Scient. Instr., v. 34: 19-21, Jan. 1963.

An apparatus designed to measure the refractive indices of the inert gases over the temperature range 77° to 273°K and at pressures up to 100 atm is described. Techniques are given for calibration of the optical cell and the production of a suitable solid specimen. The accuracy of the method is discussed and it is shown how polarizability and compressibility may be deduced from the refractive index data.

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California Inst. of Tech., Pasadena.

REFRACTIVE INDEX OF SOLID ARGON, by B. L. Smith and C. J. Pings. [1962] [4]p. incl. diagr. tables. (AFOSR-J1505) (AF AFOSR-62-141) AD 429259 Unclassified

Also published in Physica, v. 29: 555-558, May 1963.

The refractive index of solid argon at 5893A was measured in the temperature range from 78° to 84°K and at pressures up to 71 atm by determination of the angle of min deviation of a prism-shaped sample. At 83.81°K and P - 0, n - 1.26820 ± 0.00016. (Contractor's abstract)

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California Inst. of Tech., Pasadena.

INERT GASES—IDEAL ATOMS FOR RESEARCH, by B. L. Smith. [1962] [6]p. incl. illus. diagrs. [AF AFOSR-62-141] Unclassified

Published in Eng. and Sci., v. 25. 14-19, Jan. 1962.

The suitability of the inert gases, argon, neon, helium, krypton, xenon, and radon, for research in the development of the molecular theory of the physical properties of matter is discussed. The atoms are characterized by full and stable electron shells, which gives them their inert properties. They have been likened to minature 'ping-pong balls' often used in scientific theories—easy to handle mathematically because they are spherically symmetrical in their interactions. With the exception of helium, they are readily liquefied and solidified by normal low temperature methods. They may therefore be studied as gases, liquids, or solids. Work with the inert gases at the California Inst. of Tech. and their applications in other fields of study are discussed.

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

ELECTROMAGNETIC SURFACE-WAVE PROPAGATION ALONG A DIELECTRIC CYLINDER OF ELLIPTICAL CROSS SECTION, by C. W. H. Yeh. Jan. 1962, 202p. incl. illus. diagrs. table, refs. (Technical rept. no. 27) (AFOSR-1991) (AF 18(600)1113) AD 273988 Unclassified

Also published in Jour. Appl. Phys., v. 33: 3235-3243, Nov. 1962. (Title varies)

The problem of electromagnetic wave propagation along a dielectric rod of elliptical cross section is considered. The field components and the dispersion relations of the principal modes are obtained. The principal modes degenerate to modes of the circular dielectric rod as the eccentricity of the elliptical rod approaches zero. It is found that there are 2 non-degenerate principal modes which possess no cut off frequencies. The boundary conditions for the elliptical rod cannot be satisfied by using a single product term consisting of a radial and a periodic Mathieu function of a specific order to describe the field components in the regions inside and outside the rod. It is believed that an infinite series of such product terms must be used to describe the field components in both regions. It is shown that the boundary conditions may be fulfilled if the field components in 1 of the 2 regions are represented by a single product term consisting of a radial and a periodic Mathieu function of a specific order. The field components in the other region are then represented by an infinite series of such product terms, and the problem is simplified to permit analysis. The propagation characteristics of the dominant principal modes are given theoretically and experimentally. (Contractor's abstract)

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

A THEORETICAL STUDY OF THE SCATTERING OF ELECTROMAGNETIC IMPULSES BY FINITE OBSTACLES, by W. P. Brown, Jr. June 1962, 144p. incl. illus. (Technical rept. no. 28) (AFOSR-3016) (AF 18(600)1113) AD 282745 Unclassified

A general approach to the solution of pulse scattering by finite obstacles is formulated which features the identification and separate treatment of the individual terms in a wavefront expansion of the transforms of the field vectors. It is demonstrated that the dispersive effect of a finite conductivity in the scattering obstacle can be neglected for all metals but that it may be significant for poorly conducting materials such as dry earth. The wavefront technique is employed to solve the problems of the transmission of a delta pulse through a conducting dielectric slab and the reflection and diffraction of a delta pulse from a perfectly conducting sphere. The transmission problem results provide a convenient example of the usefulness of the wavefront approach. The results for the sphere problem indicate that the nature of the waves observed at a given spatial point change in time. It is shown that the penumbra and the caustic region in the vicinity of the focal line are initially of zero extent. The rates of expansion of these regions with increasing time are obtained by a consideration of the error terms in the asymptotic expansions of the fields. The temporal behavior of the near and far field zones is obtained in a similar manner. (Contractor's abstract)

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

[STUDIES OF ANTENNAS, PLASMAS, AND NON-LINEAR COMPONENTS] by C. H. Papas. Final review rept. Oct. 1962, 11p. (AFOSR-4604) (AF 18(600)1113) Unclassified

The work performed during the 7 yr tenure of this contract is reviewed. In large measure the research was of a theoretical nature, consisting of the application of Maxwell's field equations to a variety of problems arising from: antenna theory, scattering theory, electromagnetic fluctuation theory, plasma theory, and the theory of wave propagation in inhomogeneous, anisotropic dispersive media. A total of 22 technical reports have resulted from this research in addition to journal articles.

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

DOPPLER EFFECTS IN INHOMOGENEOUS

ANISOTROPIC IONIZED GASES, by K. S. H. Lee and C. H Papas. [1962] 22p. incl. diagrs. (AFOSR-J1543) (AF AFOSR-63-70) Unclassified

Also published in Jour. Math. and Phys., v. 42: 189-199, Sept. 1963.

A general formula for the Doppler effect in an inhomogeneous anisotropic medium is derived from field-theoretic considerations. The anisotropy of the medium is assumed to be caused by a magnetostatic field as in the ionosphere. The formula is applied first to the case where the medium is isotropic (zero magnetostatic field) and plane stratified in the direction of propagation, and then to the more general case where the medium is anisotropic (non-zero magnetostatic field) and plane stratified in the direction of propagation. The source of radiation is assumed to be stationary with respect to the medium.

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California Inst. of Tech. [Dept. of Electrical Engineering] Pasadena.

SUMMARY OF RESEARCH. I. VLF PROPAGATION STUDIES. II. LASER STUDIES. Final rept. Mar. 31, 1962. 7p. incl. refs. (AFOSR-2951) (AF 18(600)1552) AD 411862 Unclassified

Early work was concerned with the development of the theory of an unusual VLF antenna utilizing an existing power line as the radiating element. The system was operated successfully at 8.4 kc. Many 24 hr runs were completed and the day-night differences in the propagation mechanism were studied. A detailed analysis of the operation of the antenna system, including the use of a computer was completed. A major effort was undertaken to attempt to create round trip artificial whistler echoes using this transmitter as a source. When no delayed echoes resulted, the VLF phase of the project was dropped in favor of work on lasers. The research on lasers has encompassed 3 main studies: mode structure and radiation patterns, the mercury-zinc gaseous laser, and interactions of high intensity beams of electromagnetic radiation with matter.

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California Inst. of Tech. [Dept. of Electrical Engineering] Pasadena.

DISPERSION OF HYDROMAGNETIC WAVES (Abstract), by R W. Gould. [1962] [1]p. [AF 49(638)820] Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 145, Feb. 23, 1962.

The dispersion of waves generated by a current-carrying loop in a hydromagnetic waveguide has been studied. Attention is focused on the compressional waves (as opposed to the transverse Alfvén waves) which exhibit a low-frequency cutoff and strong dispersion. The impulse response has been obtained as well as the response to a damped sinusoidal driving current. The received wave trains exhibit a behavior similar to that discussed in the classic treatment by Sommerfeld and Brillouin of optical dispersion. The problem of measuring phase velocity with sinusoidal wave trains of finite duration and with pulses will be discussed.

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California Inst. of Tech. [Dept. of Electrical Engineering] Pasadena.

EXPERIMENTAL OBSERVATIONS OF COMPRESSIONAL HYDROMAGNETIC WAVES (Abstract), by D. G. Swanson and R. W. Gould. [1962] [1]p. [AF 49(638)820] Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 152, Feb. 28, 1963.

Observations have been made of the compressional hydromagnetic wave in a Wilcox-type hydrogen plasma-filled waveguide. The impulse response of the system has been measured by using a 50-nsec current pulse through a loop immersed in the plasma and by detecting the signal 20 and 40 cm away with magnetic probes. The Fourier transforms of the resulting oscillograms lead to a dispersion relation that has been compared with a theoretical dispersion relation. The measured waveguide cutoff frequency (ω_0) has been observed to lie consistently lower than the expected value by as much as a factor of 2. The variation of this error with pressure suggests the presence of impurities. This hypothesis is consistent with our measurements on the torsional wave that give the same result for the Alfvén speed as is derived from ω_0. The linear dependence of ω_0 upon the magnetic field has been verified. Theoretical considerations, including effects such as nonuniform density, modified boundary condition at the wall, Hall term in Ohm's Law, generally lead to a higher cutoff frequency, and, therefore, do not seem to explain our result.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

AMES TESTS ON THE FLUTTER OF CYLINDRICAL SHELLS, by R. O. Stearman, M. H. Lock, and Y. C. Fung. Dec. 1962 [59]p. incl. illus. diagrs. tables, refs. (Aeroelasticity and Structural Dynamics rept. no. SM 62-37) (AFOSR-4727) (AF AFOSR-62-374) Unclassified

Two series of experiments on the flutter of thin-walled circular cylinders were performed at the Ames Unitary Plan Wind Tunnel. In the first series, although the model had a radius-to-thickness ratio of 1333, and was designed to flutter according to all published theories based on potential flow, no flutter occurred except in the vicinity of buckling conditions. In the second series,

models having radius-to-thickness ratios 1951 and 2509 were tested, and flutter was observed. This paper describes the experimental results and their interpretations. (Contractor's abstract)

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California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

FORMULAS FOR THE DETERMINATION OF THE MATERIAL DAMPING OF A CYLINDRICAL SHELL BY A DECAYING FREE VIBRATION. APPENDIX: APPROXIMATION FORMULAS FOR BESSEL- AND HANKEL-FUNCTIONS, by H. Krumhaar. June 1962, 47p. incl. diagr. refs. (Aeroelasticity and Structural Dynamics rept. no. SM 62-31) (AFOSR-2995) (AF 49(638)220) AD 610436 Unclassified

Formulas are given to determine the structural damping of a thin cylindrical shell by a decaying free vibration in still air. The material damping is assumed to be of the viscous type. To account for the elastic forces the linearized Timoshenko equations and Reissner's shallow shell equations were used. To account for the acoustic pressure due to the surrounding air the acoustic pressure derived for a vibrating cylindrical shell of infinite length was employed. The trapezoidal rule is applied to the integral representations of Bessel and Hankel functions. In this way approximation formulas for these functions are obtained. (Contractor's abstract)

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California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

EXPERIMENTS ON THE FLUTTER OF FLAT AND SLIGHTLY CURVED PANELS AT MACH NUMBER 2.81, by W. J. Anderson. June 1962, 72p. incl. illus. diagrs. tables, refs. (Aeroelasticity and Structural Dynamics rept. no. SM 62-34) (AFOSR-2996) (AF 49(638)220) AD 419378 Unclassified

The series of panel flutter tests were carried out in the Jet Propulsion Laboratory's 12 in. supersonic wind tunnel. Flat and slightly curved panels were tested at Mach number 2.81. The flat, rectangular panels were designed to study 2-dimensional flutter. They were clamped at front and rear with free sides which extended into the boundary layer at the sides of the tunnel. These panels flutter in a 2-dimensional mode which occurred at a thickness ratio approx 15% different from the predictions of existing theory. One of the panels exhibited a 3-dimensional "rocking" flutter which has not been observed or discussed before. A theory is developed for this type of flutter. The slightly curved panels were shallow circular cylindrical shells with the generators perpendicular to the flow direction. These panels were all of aspect ratio one. It was found that the effect of curvature was destabilizing and that the effect of internal pressurization was stabilizing. (Contractor's abstract)

220

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

FLUTTER OF A RING OF PANELS, by R. O. Stearman. July 1962, 59p. incl. diagrs. tables, refs. (Aeroelasticity and Structural Dynamics rept. no. SM 62-35) (AFOSR-3121) (AF 49(638)220) AD 610437 Unclassified

A theoretical investigation was made on the flutter of a grid of panels in a supersonic flow. The problem is formulated by considering this structure as a limiting case of a more general configuration composed of a ring of panels (i.e., an axially stiffened cylindrical shell) whose outer surface is exposed to a supersonic flow parallel to its axis. It is shown that the flutter analysis of this more general configuration can be reduced to the analysis of an 'equivalent' single panel using the circulant matrix idea. The reduction procedure, applicable to most cyclic configurations, allows for all types of inter-element (panel) coupling and is subject to the sole restriction that the dynamic phenomenon be satisfactorily described by linear theory. (Contractor's abstract)

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California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

ON CORRUGATION-STIFFENED PANELS, by Y. C. Fung. June 1962, 28p. incl. diagrs. (Aeroelasticity and Structural Dynamics rept. no. SM 62-33) (AFOSR-3122) (AF 49(638)220) AD 429770 Unclassified

A corrugation-stiffened panel consists of a flat plate and a cylindrically corrugated plate welded together along lines of contact. Such a panel appears on air- and space-craft mainly for its thermal-stress relieving characteristics. In some current publications such a plate is treated as an orthotropic plate. It is pointed out that the ordinary plate theory cannot be applied to the corrugation-stiffened panel, because the basic twisting moment relation, $M_{xy} = M_{yx}$ becomes untenable. A difference-differential equation is established here for the corrugation-stiffened panel. In an approximation, the difference-differential equation is written as a partial differential equation which has the same form as the orthotropic plate equation. The present theory tells how to interpret the coefficients as related to the plate geometry. Some consequences with regard to the static deflection and vibration modes and frequencies of corrugation-stiffened panels are discussed. If the formula to correct the experimental envelope of supersonic flutter boundaries given by Kordes, Tuovila, and Guy, is used a somewhat different boundary is obtained but the modification is not large. (Contractor's abstract)

222

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

SOME NONLINEAR VIBRATION AND RESPONSE PROBLEMS OF CYLINDRICAL PANELS AND SHELLS, by B. E. Cummings. June 1962, 131p. incl. diagrs. table, refs. (Aeroelasticity and Structural Dynamics rept. no. SM 62-32) (AFOSR-3123) (AF 49(638)220) AD 432757 Unclassified

Large amplitude vibrations and forced responses of curved panels and shells are studied by the application of the shallow shell equation. The Galerkin procedure is used to reduce the nonlinear partial differential equations to ordinary nonlinear equations. Marked differences are found between the behavior of curved panels and cylindrical shells. Relations for the dependence of the free vibration period on amplitude are given. A 2 mode analysis of the cylindrical shell problem is included. The curved panel is found to exhibit a buckling phenomenon for the simple "breathing" modes. Shock response methods are used to predict dynamic buckling of the curved panel and the predictions are verified by numerical integration. The cylindrical shell vibrations and responses are found to be governed by Duffing's equation and certain of the well-known properties of Duffing's equation are applied to the cylindrical shell dynamics. The 2 mode analysis of the cylindrical shell is shown to exhibit weak coupling, allowing the separate excitation of the coupled modes. Some numerical results are given. (Contractor's abstract)

223

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

SUPERSONIC FLUTTER OF TWO-DIMENSIONAL FLAT PANELS: AN EXPERIMENTAL EVALUATION OF THE THEORY, by M. H. Lock. [1962] [7]p. incl. diagrs. (AFOSR-5271) (AF 49(638)220) AD 414799 Unclassified

Also published in Proc. Fourth U. S. Nat'l. Congress Appl. Mech., California U., Berkeley (June 18-21, 1962). New York, Amer. Soc. Mech. Engineers, v. 2: 1351-1357, 1962.

An experimental evaluation of the theory of supersonic flutter of 2-dimensional flat panels was undertaken. Experimental flutter boundaries were obtained between Mach numbers 1.15 and 1.5 and a detailed comparison of theory and experiment carried out. Agreement between the theoretical and experimental flutter boundaries is poor in the lower supersonic Mach number range but improves at the higher Mach numbers. The theory appears to be overconservative for the prediction of flutter boundaries at the lower supersonic Mach numbers. A possible cause of this inadequacy of the theory is discussed.

224

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

A NOTE ON THE APPLICATION OF THE QUASI-STEADY SUPERSONIC-FLOW THEORY TO FLUTTER ANALYSIS, by M. H. Lock. [1962] [1]p. [AF 49(638)-220] Unclassified

Published in Jour. Aerospace Sci., v. 29: 1133, Sept. 1962.

Application of the quasi-steady supersonic-flow theory to the problem of the flutter of 2-dimensional panels led to the prediction that all panels would flutter (regardless of stiffness) if the flow Mach number was less than $\sqrt{2}$, whereas analyses that employed the complete linearized supersonic-flow theory indicated that sufficiently stiff panels would not flutter in this range. On the other hand, at Mach numbers above $\sqrt{2}$ there was good agreement between the predictions of flutter analyses employing both aerodynamic theories. The purpose of this note is to clarify this situation.

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California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

THE HYPERSONIC APPROXIMATION FOR THE SHOCK STRUCTURE OF A PERFECT GAS WITH THE SUTHERLAND VISCOSITY LAW, by W. B. Bush. Feb. 1962, 24p. incl. diagrs. (AFOSR-2257) (AF 49(638)-476) AD 275884 Unclassified

The classical Navier-Stokes treatment of the shock wave structure is investigated for a perfect gas with constant specific heats. The viscosity of the gas is prescribed according to the Sutherland law. The Prandtl number is 3/4. The limiting forms of the solution as the upstream flow Mach number approaches infinity, with all other parameters held fixed, are studied. Two distinct asymptotic series, as $M_1 \to \infty$, are found for the portions of the shock adjacent to the uniform regions upstream and downstream of the shock and these expansions are matched in an intermediate region of common validity. The leading terms of a uniformly valid expansion are obtained by combining elements from both expansions. Special attention is given to the entropy and the entropy production rate in the shock wave. The effective thickness x of the shock is found and the Reynolds number based on this effective thickness is shown to be: $Re_{shock} = \frac{\rho_1 u_1 x^*}{\mu_1} \sim M_1$ as $M_1 \to \infty$. It is also shown that if the viscosity law is generalized to $\bar{\mu} = \bar{T}^n$, then $Re_{shock} \sim M_1^{2n}$ as $M_1 \to \infty$. (Contractor's abstract)

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

SLENDER WINGS AT HIGH ANGLES OF ATTACK IN HYPERSONIC FLOWS, by J. D. Cole and J. J. Brainerd. [1961] [22]p. incl. illus. diagrs. tables. (AFOSR-J907) (AF 49(638)476); Unclassified

Presented at ARS Internat'l. Hypersonic Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 321-341, 1962.

For abstract see item no. 155, Vol. V.

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California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

LIFT OF SLENDER DELTA WINGS ACCORDING TO NEWTONIAN THEORY, by A. F. Messiter. [1962] [9]p. incl. diagrs. refs. (AF 49(638)476) AD 413121 Unclassified

Published in AIAA Jour., v. 1: 794-802, Apr. 1963.

An approximate system of equations is derived to describe the inviscid flow past a flat slender wing at angle of attack, in the limit $\gamma \to 1$ and $M_\infty \sin\alpha \to \infty$. The aspect ratio is required to approach zero at the same rate as the Mach angle in the flow behind the shock wave. Only a single parameter appears in the resulting equations, and a similarity law therefore can be written expressing a correction to the Newtonian normal-force coefficient. For the delta wing, a correlation of experimental data according to the similarity law is shown, and the first terms of the solution are derived under the assumption that the similarity parameter is small (vertex angle much smaller than Mach angle). (Contractor's abstract)

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California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

THE EFFECT OF HEAT TRANSFER ON SEPARATION OF LAMINAR COMPRESSIBLE BOUNDARY LAYERS, by S. B. Savage. June 1, 1962, 43p. incl. diagrs. tables, refs. (Technical rept. no. 2) (AFOSR-2946) (AF 49(638)916) AD 277354 Unclassified

Tani's integral method (Jour. Aeronaut. Sci., v. 21: 487-504, 1954) is extended to treat laminar 2-dimensional compressible boundary layers with heat transfer and arbitrary pressure gradient for both attached and separated flows. A carefully chosen one-parameter family for the velocity profiles and a universal stagnation enthalpy profile are assumed for attached flows. The accuracy of the method is examined by comparing the results with several exact numerical solutions and satisfactory agreement is obtained. For separated flows one-parameter families are assumed for both the velocity and stagnation enthalpy profiles. In this case the accuracy of the method is poor; however, suggestions are made as to how it might be improved within the present framework. (Contractor's abstract)

229

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

STABILITY OF THE COMPRESSIBLE LAMINAR BOUNDARY LAYER, by L. Lees and E. Reshotko. [1961] [36]p. incl. diagrs. table, refs. (AFOSR-3208) [AF AFOSR-62-29] Unclassified

Also published in Jour. Fluid Mech., v. 12: 555-590, Apr. 1962.

The present study of the stability of the compressible laminar boundary layer shows that, although the basic stability mechanisms are the same as for incompressible flow, the relative importance of the various mechanisms changes considerably with Mach number. Instead of being nearly constant across the boundary layer, the amplitude of inviscid pressure fluctuations decreases markedly with distance from the plate surface at Mach numbers greater than 3. Because of this behavior the rate of absorption (or production) of disturbance energy near the critical layer is greatly reduced, as compared with subsonic or slightly supersonic flows. At Mach numbers less than about 2, dissipation effects are minor, but they become extremely important at high Mach numbers. The minimum critical Reynolds number for an insulated flat plate boundary layer decreases with increasing Mach number in the range $0 \le M_e \le 3$. Since the wave-number varies like $1/M_e^2$ when $M_e \gg 1$, the minimum critical Reynolds number is likely to increase sharply at hypersonic speeds. Numerical examples illustrating the effects of compressibility, including neutral stability characteristics, are obtained.

230

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

MATCHED-CONIC APPROXIMATION TO THE TWO FIXED FORCE-CENTER PROBLEM, by P. A. Lagerstrom and J. Kevorkian. [1962] [9]p. (AFOSR-J801) (In cooperation with Douglas Aircraft Co., Inc., Santa Monica, Calif.) (AF AFOSR-62-256) AD 413865 Unclassified

Presented at Seventeenth annual meeting of the Amer. Rocket Soc., Los Angeles, Calif., Nov. 13, 1962.

Also published in Astronom. Jour., v. 68: 84-92, Mar. 1963.

Planar motion of a particle of negligible mass from the neighborhood of a gravitational center (the "earth") of mass $1-\mu$ to the neighborhood of a second center (the moon) of mass μ is studied by asymptotic methods for the case $\mu \ll 1$. The calculations are carried out for the case of 2 fixed centers. It is pointed out, however,

that the methods used are also applicable to the case of the 2 centers rotating around their center of mass, that is, to the limiting case of the restricted 3-body problem for which the second mass is much smaller than the first. A uniformly valid solution describing the passage from the earth to the moon and the motion in the neighborhood of the moon is obtained. Each part of the motion is in the first approximation a Keplerian conic relative to the earth and moon, respectively. However, these conics cannot be matched directly: In order to determine the second part, as well as the subsequent motion, it is necessary to compute a correction of order μ to the first part. This statement is equally true for the restricted 3-body problem. (Contractor's abstract)

231

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

THE TWO VARIABLE EXPANSION PROCEDURE FOR THE APPROXIMATE SOLUTION OF CERTAIN NON-LINEAR DIFFERENTIAL EQUATIONS, by J. Kevorkian. Dec. 13, 1962, 114p. incl. diagrs. refs. (Rept. no. SM 42620) (In cooperation with Douglas Aircraft Co., Inc., Santa Monica, Calif.) (AF AFOSR-62-256) AD 426822; AD 437675 Unclassified

Presented at 1962 Summer Inst. in Dynamical Astronomy, Yale U., New Haven, Conn.

A method is presented for deriving the asymptotic representation valid for large times for the motion of a particle under the influence of a predominantly linear restoring force and small nonlinear perturbations. It is shown that such an asymptotic representation must be a function of two time variables, in order to depict the behavior of the solution. The basic ideas are explained by the liberal use of simple examples, and the method is also applied to two idealized problems in celestial mechanics.

232

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

MICROWAVE PROBING OF IONIZED GAS FLOWS, by R. G Jahn. Feb. 1962 [32]p. incl. diagrs. refs. (Technical note no. 5) (AFOSR-2334) (AF 49(638)758) AD 272789 Unclassified

Also published in Phys. Fluids, v. 5: 678-686, June 1962.

The measurement of free electron densities and collision frequencies in ionized gas flows by a probing transverse microwave beam is described. Interpretation of the observed reflection and transmission coefficients and their phases is developed on the basis of an idealized plane wave-plane slab model, for which typical results are displayed. Application of the device and technique to the build-up of ionization behind a strong shock in argon is outlined. Effects of various departures of the microwave radiation patterns and flow configurations from the slab assumptions are discussed and examples evaluated. (Contractor's abstract)

233

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

RADIATIVE TRANSFER STUDIES AND OPACITY CALCULATIONS FOR HEATED GASES, by S. S. Penner and R. W. Patch. Jan. 1962, 42p. incl. diagrs. refs. (Technical rept. no. 6) (AFOSR-1901) (AF 49(638)984) AD 271787 Unclassified

Also published in High Temperatures in Aeronautics; Proc. Symposium held in Turin to celebrate the 50th anniversary of the Laboratorio di Aeronautica, Politecnico di Torino (Italy) (Sept. 10-12, 1962), ed. by C. Ferrari. Milano, Tamburini Editore, 1964, p. 211-238.

Representative radiative transfer studies and recent developments in opacity calculations for heated gases are outlined. The following topics are treated: the formulation of radiative transfer problems; the definition of opacities and radiation free paths for the important limiting cases of a transparent gas and an opaque gas; the reformulation of the conservation equations with proper allowance for radiative energy transport; selected calculations of spectral absorption coefficients in molecular systems; and continuum radiation in plasmas containing polyelectronic, partially or completely ionized atoms.

234

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

SIMILARITY PARAMETERS FOR REACTING, MULTI-COMPONENT GAS MIXTURES WITH RADIATIVE ENERGY TRANSFER, by S. S. Penner, M. Thomas, and G. Adomeit. [1962] 12p. incl. diagr. [Technical rept. no. 7] (AFOSR-2578) (AF 49(638)984) AD 276279 Unclassified

The similarity groups for multicomponent, reacting gas mixtures with radiative energy transport are identified for a number of special cases that are of practical interest. The results are used to draw conclusions concerning the feasibility for scaling the radiative properties of reacting gas mixtures. It has been concluded that significant model testing of the radiative properties of reacting gas flows is possible for those cases in which radiant energy emission does not produce significant perturbations in the flow field (e.g., transparent gases) provided we are satisfied in scaling the radiative properties per unit area of reacting mixture.

235

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

RESEARCH ON ABSOLUTE INTENSITY MEASUREMENTS AND GAS EMISSIVITIES AT ELEVATED TEMPERATURES AND PRESSURES, by S. S. Penner. Final rept. [1962] 2p. (AFOSR-4403) (AF 49(638)984) Unclassified

Most of the experimental and theoretical studies performed under this contract have been described in contract reports and have been published, or will be published, in the open literature. A list of 14 completed studies is given in addition to a brief notation concerning work in progress.

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

APPROXIMATE SPECTRAL ABSORPTION COEFFICIENT CALCULATIONS FOR ELECTRONIC BAND SYSTEMS BELONGING TO DIATOMIC MOLECULES, by R. W. Patch, W. L. Shackleford, and S. S. Penner. [1961] [9]p. (AFOSR-4919) (AF 49(638)984) AD 414925 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 263-271, July Sept. 1962.

For abstract see item no. 169, Vol. V.

237

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

TEMPERATURE MEASUREMENTS ON THE $OH^2\Sigma - {}^2\Pi$ BAND SYSTEM FOR A TRANSPARENT GAS IN A SHOCK TUBE, by R. Watson. [1962] [3]p. incl. diagrs. (AFOSR-J96) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)984] and Office of Naval Research) AD 400061 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 301-303, July Sept. 1962.

Calculations were made of the ratio of intensities of 2 general fractions (such as are intercepted by 2 slits) of the OH (0, 0)band as a function of gas temperature and positions of the fractions in the band. Application of the fractional band intensity ratios to temperature measurements of radiating transparent gases are discussed.

238

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

FURTHER SHOCK-TUBE STUDIES BY INFRARED EMISSION OF THE DECOMPOSITION OF AMMONIA, by T. A. Jacobs. [1962] [3]p. incl. diagrs. (AF 49(638)-984) Unclassified

Published in Jour. Phys. Chem., v. 67: 665-667, Mar. 1963.

For abstract see item no. 168, Vol. V.

239

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

PROCEDURE FOR RELIABLE PREPARATION OF SHOCK TUBE TEST GAS MIXTURES CONTAINING WATER VAPOR, by R. Watson. [1962] [2]p. incl. diagr. [AF 49(638)984] Unclassified

Published in Rev. Scient. Instr., v. 33: 1113-1114, Oct. 1962.

Shock tube spectroscopic measurements of the emission, absorption, and kinetics of H_2O and OH are usually performed with test gas mixtures of water vapor diluted in argon in order to readily achieve high shocked gas temperatures. In addition to the uncertainties of the overall concentration introduced by the surface adsorption of the water vapor, concentration gradients may be set up within the shock tube so that samples drawn from the tube just before firing may not be representative of that in the region of observation. A successful procedure for overcoming these difficulties was arrived at through use of a continuous flushing operation. This system used a regulated argon flow, bubbled continuously through a series of bulbs containing degassed water. A flow meter monitored approximate flow rates, regulation being achieved by bellow valves at the inlet of the system. A cold trap prevented the water vapor from contaminating the vacuum pump oil. A small air conditioning unit recirculating the air within an insulated enclosure allowed controlled temperatures of ~25 °C to be maintained. Analyses made at both ends of the shock tube, 10 min or more after the flushing was completed, showed that adsorption equilibrium was attained since the concentration was uniform and remained constant at the value calculated from the mixing supply conditions.

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

SIMILARITY PARAMETERS FOR RADIATIVE ENERGY TRANSFER IN ISOTHERMAL AND NON-ISOTHERMAL GAS MIXTURES, by S. S. Penner, M. Thomas, and G. Adomeit. Dec. 1962. 45p. incl. diagrs. (Technical rept. no. 1) (AF AFOSR-63-71) AD 407135 Unclassified

Presented in part at TABSTONE meeting, San Diego, Calif., Jan. 1963.

The similarity groups for multicomponent, reacting gas mixtures with radiative energy transport are derived. The resulting relations are used to consider the feasibility of scaling for flow processes with radiative energy transport under highly simplified conditions. The scaling parameters are derived for radiant energy emission from isobaric and isothermal gases for arbitrary opacities and various spectral line and molecular band models. Scaling parameters for radiant energy emission from isobaric but non-isothermal systems are

discussed for arbitrary opacities and various spectral line and molecular band models under the restrictions imposed on the allowed temperature profiles for dispersion and Doppler lines by the Eddington-Barbier approximation. Finally, the radiative scaling properties for representative temperature profiles are considered for both collision-broadened and Doppler-broadened line profiles on the basis of exact numerical calculations that were performed for a rotational spectral line belonging to a molecular vibration-rotation band. (Contractor's abstract)

241

California Inst. of Tech. W. M. Keck Lab. of Engineering Materials, Pasadena.

THE INFLUENCE OF TEMPERATURE AND PREFERRED ORIENTATION ON HALL COEFFICIENT AND RESISTIVITY OF PURE TITANIUM, by L. C. Roesch. Nov. 1962. 111p. incl. illus. diagrs. tables, refs. (AFOSR-4001) (AF 49(638)1034) AD 289535 Unclassified

The Hall coefficient is found to depend strongly on temperature and crystalline texture. At room temperature it has a value of -1.8×10^{-11} m^3 coulomb in two specimens, whereas in the third it equals 1.2×10^{-11} m^3 - coulomb. Several factors including impurities, changes in the scattering mechanism, size effects, and crystallographic anisotropy, which could account for the observed differences, are discussed and it is proposed that crystallographic orientation is the most influential factor. From the measured data and a phenomenological theory of the Hall effect developed in the case of single crystals, values of the components of the galvanomagnetic tensor, which replaces the scalar Hall coefficient of isotropic media, are calculated and discussed in connection with a possible model of the Fermi surface of titanium. Contractor's abstract)

242

California Inst. of Tech. [M. K. Keck Lab. of Engineering Materials] Pasadena.

VACUUM X-RAY DIFFRACTOMETER FOR HIGH TEMPERATURE STUDIES OF METALS SENSITIVE TO CONTAMINATION BY OXYGEN AND NITROGEN, by R. H. Willens. [1962] [8]p. incl. illus. diagrs. table, refs. [AF ?(638)1034] Unclassified

Published in Rev. Scient. Instr., v. 33: 1069-1076, Oct. 1962.

An x-ray diffractometer operating in vacuum has been designed and constructed to study metals sensitive to oxygen and nitrogen contamination at elevated temperature. The instrument operates in a vacuum of 2×10^{-6} mm Hg in which the partial pressure of oxygen and nitrogen is several orders of magnitude lower than the total pressure. The specimen is heated by radiation from a resistance-type furnace to 1200°C. With this instrument it is possible to obtain lattice parameters which are accurate to one part in forty thousand. The thermal expansion of titanium has been investigated up to 650°C. Between room temperature and 400°C the expansion coefficients in directions perpendicular and parallel to the c axis are 9.41×10^{-6} and 11.18×10^{-6}/°C, respectively. For a random polycrystalline sample, the mean expansion coefficient is 10.0×10^{-6}/°C. (Contractor's abstract)

243

California Inst. of Tech. [Mechanical Engineering Lab.] Pasadena.

A VACUUM X-RAY DIFFRACTOMETER FOR HIGH TEMPERATURE STUDIES AND AN INVESTIGATION OF THE ALLOTROPIC TRANSFORMATION OF TITANIUM, by R. H. Willens. Final technical rept. Dec. 1961, 131p. incl. illus. diagrs. tables, refs. (AFOSR-1839) (AF 18(600)1561) AD 270632 Unclassified

A vacuum high temperature x-ray diffractometer was constructed to study metals, sensitive to O and N contamination, up to 1200°C. The factors which affect the accuracy of the diffractometer method and the proper choice of extrapolation functions are discussed. It is shown that this instrument can determine lattice parameters with an accuracy of one part in forty thousand. The thermal expansion of titanium was investigated to 650°C and the c/a parameter is found to increase rapidly above 400°C. This variation of c/a is correlated with other properties of Ti to formulate a band model. On the basis of this model it is shown that the electrons can give an appreciable positive contribution to the free energy as the transformation temperature is approached and it is proposed that this is the main factor causing the instability of the low temperature modification of Ti. (Contractor's abstract)

244

California Inst. of Tech. Palomar Observatory, Pasadena.

COMMENTS ON MASS-EJECTION MECHANISMS IN RED GIANTS, by R. Weymann. [1962] [11]p. incl. refs. (AFOSR-2407) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 295858 Unclassified

Also published in Astrophys. Jour., v. 136: 476-486, Sept. 1962.

Consideration of the basic energy and momentum requirements, together with the results of observations of the circumstellar lines in α Ori, seems to demand an extensive hot region surrounding the star, if purely hydrodynamic processes are to explain the mass ejection. The amount of Balmer emissions which might be expected from such a hot region is discussed, as is the emission in the ultraviolet lines of C IV at 1550A. At temperatures in excess of 10^5 degrees nearly all the power must be dissipated as radiation, since there is little residual thermal or kinetic energy in the matter great distances from the star. Therefore, one has the problem of disposing of radiation losses of a magnitude

greater than those considered here. Mechanisms involving continuous absorption of radiation are also discussed. No core of CH or CN is visible, both well known as interstellar lines, and whether molecules of grains would form under the conditions in the envelope is not known. To insure sufficient coupling between grains and the gas, it is necessary for the grains to be small enough to scatter as $1/\lambda^4$ in the observable region of the spectrum and in the infrared. This would lead to the envelope being opaque in the far ultraviolet and there is no evidence of this. The energy density for O. C. Ellson's Lyman-α mechanism to operate is such that barium should be completely doubly ionized, in contradiction to the observations. If they are interpreted in terms of a single shell of matter moving only under gravity, rather than as steady flow, the absence of any observable change in velocity [illegible]ngth of the lines would require the matter to be at such a distance from the star that the envelope would be resolvable from the star. No ejection mechanism so far proposed is entirely satisfactory, though the possibilities are far from exhausted. (Contractor's abstract, modified)

245

California Inst. of Tech. Palomar Observatory, Pasadena.

PHYSICAL CONDITIONS IN THE CIRCUMSTELLAR ENVELOPE OF α ORIONIS, by R. Weymann. [1962] [22]p. incl. diagrs. tables, refs. (AFOSR-2406) (AF 49(638)21) AD 406807 Unclassified

Also published in Astrophys. Jour., v. 136: 844-865, Nov. 1962.

A curve-of-growth analysis of the circumstellar lines in α Ori based on high-dispersion spectrograms is used to infer the physical conditions in the circumstellar envelope. The number of atoms in the line of sight is of the order of 10^{22} cm^2, while the ejection rate was estimated to be 4×10^{-6} M$_\odot$/yr. Hydrogen is probably neutral and second ionization of the metals probably unimportant. The kinetic temperature is of the order of 1000°K. Except for H and K, the radial velocities of all the neutral and ionized lines are identical. No detectable systematic change in the velocity or strength of the circumstellar has occurred over the last 20 yr. The evidence for an extensive chromospheric region surrounding the star is discussed. A brief discussion of α Herculis and a re-examination of the existence of a high degree of concentration of matter in the envelope into clumps indicate that such concentrations may be very slight, if they exist at all. (Contractor's abstract)

246

California Inst. of Tech. Palomar Observatory, Pasadena.

STUDIES OF THE PECULIAR A STARS. I. THE OXYGEN-ABUNDANCE ANOMALY, by W. L. W. Sargent and L. Searle [1962] [14]p. incl. diagrs. tables, refs. (AFOSR-2446) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49-(638)21) AD 295859 Unclassified

Also published in Astrophys. Jour., v. 136 408-421, Sept. 1962.

This study investigates the oxygen weakness in peculiar A stars, how it correlates with other spectral peculiarities, and whether it is to be regarded as an abundance effect. Equivalent widths of the infrared oxygen blends $\lambda\lambda$ 7772-7775 and λ 8446 have been measured in 20 peculiar A stars and 3 A-type normal stars. The neighboring pair of Mg II lines at λ 7877 and λ 7896 have also been measured. Both the O I and Mg II lines are quite insensitive to temperature and electron pressure and in normal stars behave almost identically in the range B8-F5. The oxygen lines are very much weaker in some peculiar stars than in the standard stars; this effect is strongly correlated with the B - V color. The Mg II lines show no comparable trend. The results are interpreted as indicating abundance variations among the Ap stars. Oxygen is deficient with respect to hydrogen by factors ranging from 8 to more than 100 in all Ap stars of the Si-Eu-Cr, Eu-Cr, Eu-Cr-Sr, and Sr classes, while in the Mn stars the oxygen abundance is normal. Assuming that they originated with a normal composition, the observed spectra of the oxygen-deficient Ap stars demand that, in general, O must have been transmuted into one or more of the elements H, He, C, N, Ne, and perhaps F. Some possible nuclear reactions (which must involve only H, He, and O^{16}) that could be responsible for the inferred oxygen deficiency are discussed. (Contractor's abstract)

247

California Inst. of Tech. Palomar Observatory, Pasadena.

RED GIANTS WITH EXTREME METAL DEFICIENCIES, by G. Wallerstein, J. L. Greenstein and others. [1962] [24]p. incl. illus. diagrs. tables, refs. (AFOSR-2475) (AF 49(638)21) AD 406809 Unclassified

Also published in Astrophys. Jour., v. 137: 280-300, Jan. 1963.

The 3 field stars, HD 122563, HD 165195, and HD 221170, similar to giants in metal-poor globular clusters, which have been studied, show decreases in the average metal/hydrogen ratios by factors of 800, 500, and 500, respectively, compared with the sun. The abundance ratios of other elements to iron resemble those in the sun, with important exceptions. Manganese and vanadium are deficient with respect to iron, by a factor of 3. In HD 122563 all elements heavier than zinc are deficient compared with iron by a factor of 50, yielding a total deficiency of about 50,000 for the heavy elements. It is assumed that the elements were synthesized from hydrogen early in the history of our Galaxy. These stars were formed when the interstellar medium was almost entirely hydrogen, between 10^7 and 10^9 yr after star formation began. Their metallic constituents were formed and ejected from massive, rapidly evolving stars of extremely low metal content. Processing at high temperatures synthesized the elements from sodium through nickel which are now present in all 3 stars. The material that went into HD 122563 is drastically deficient in all elements

produced by the addition of neutrons to the iron peak, whereas light elements produced by neutron addition--aluminum and scandium--exist in normal amounts or are only slightly deficient. It has been interpreted to mean that when a flux of free neutrons became available, the progenitors of the light s-process elements were present, but the iron peak elements were rare or absent. The europium in HD 122563 may have been produced by the s-process, a very unexpected result. The presence of europium in HD 165195, in at least the normal ratio to the other elements, raises difficulties concerning r-process nucleosynthesis, since type I supernovae of small mass may not have begun to appear at the early epoch when the star was formed. (Contractor's abstract)

248

California Inst. of Tech. Palomar Observatory, Pasadena.

THE INFRARED OI AND MgII LINES IN THE SPECTRA OF THE METALLIC-LINE STARS, by W. L. W. Sargent and L. Searle. [1962] [4]p. incl. diagr. table, refs. (AFOSR-2476) (AF 49(638)21) AD 295860 Unclassified

Also published in Astrophys. Jour., v. 136: 671-674, Sept. 1962.

A recent study of the infrared OI and MgII lines in 20 peculiar A-type stars (see item no. 246) has revealed striking oxygen-abundance anomalies which are strongly correlated with the type of spectral peculiarity. The 'Mn' stars have a normal oxygen abundance, while the redder Ap stars (the Eu-Cr and the Sr stars) are oxygen-deficient by factors up to 100. The chief aim in this note is to point out that Am and Ap stars of similar colors and absolute magnitudes behave very differently in their infrared O/Mg ratio. This lends support to the view that the anomalous weakness of the OI lines in many of the Ap stars is not a consequence of peculiar atmospheric structures but is due to real abundance deficiencies in these stars. Moreover, these results indicate that there is little hope of explaining the spectral peculiarities in both the Am and Ap stars as being aspects of the same phenomenon.

249

California Inst. of Tech. Palomar Observatory, Pasadena.

A DETAILED ANALYSIS OF THE SPECTRUM OF EPSILON VIRGINIS, by G. Cayrel and R. Cayrel. [1962] [39]p. incl. diagrs. tables, refs. (AFOSR-2750) (AF 49(638)21) AD 422787 Unclassified

Also published in Astrophys. Jour., v. 137: 431-469, Feb. 15, 1963.

Lines in the spectral range λλ 4500-8700A have been identified on tracings of the spectrum of ε Virginis ('G6 III'). Three plates had a dispersion of 1 A/mm and 5 plates a dispersion of 2.8 A/mm. The equivalent widths of 1400 lines have been measured. A detailed analysis of the atmosphere has been performed, leading to the values: T_{eff} = 4940°K ± 150°; log g = 2.7 ± 0.2; and log A = log A ☉ ± 0.2 (probable errors). There is a good agreement between the spectroscopic gravity and the value obtained from reasonable values of the mass and the radius of the star. The chemical composition of the atmosphere agrees with the solar composition within the probable error, except perhaps for Na. No systematic enrichment in heavy-element abundance can be detected between the birth of the sun and that of ε Virginis, about 10^9 yr ago. Higher accuracy is needed to reveal any difference that might be less than a factor of 2.

250

California Inst. of Tech. Palomar Observatory, Pasadena.

THE LUMINOSITIES AND COMPOSITIONS OF THE HIGH GALACTIC-LATITUDE SUPERGIANTS 89 HERCULIS AND HD 161796, by L. Searle, W. L. W. Sargent, and J. Jugaku. [1962] [12]p. incl. diagr. tables, refs. (AFOSR-3017) (In cooperation with Carnegie Inst. of Washington, D. C.) (AF 49(638)21) AD 406808 Unclassified

Also published in Astrophys. Jour., v. 137: 268-279, Jan. 1963.

A spectrophotometric analysis is made of the high-galactic-latitude supergiants HD 161796 (F3 Ib) and 89 Herculis (F2 Ia), together with the low-latitude standard star ζ Cassiopeiae (F0 Ia). It is found that all 3 stars have normal abundances of the metals and rare earths relative to α Persei. Spectroscopic absolute magnitudes are derived for the high-latitude supergiants, using ζ Cas and α Per as calibration stars. It is concluded that both 89 Her and HD 161796 could have reached their present heights above the galactic plane in times comparable with their estimated times of evolution from the main sequence if they were expelled from the plane at the time of their formation with velocities of the order of 100 km/sec. The spectroscopic data are consistent with the suggestion made by Bonsack and Greenstein (1956) and by Herbig (1958) that the high-galactic-latitude supergiants are evolved "runaway" stars. (Contractor's abstract)

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California Inst. of Tech. Palomar Observatory, Pasadena.

AN ANALYSIS OF THE ABSOLUTE ENERGY DISTRIBUTION IN THE SPECTRUM OF SU DRACONIS, by J. B. Oke, L. P. Giver, and L. Searle. [1962] [15]p. incl. diagrs. tables, refs. (AFOSR-J121) (AF 49(638)21) AD 406448 Unclassified

Also published in Astrophys. Jour., v. 136: 393-407, Sept. 1962.

Photoelectric spectrum scans of the cluster-type variable SU Dra have been obtained and used to determine the absolute energy distribution in the spectrum at different phases. By comparison with fluxes computed from model atmospheres, the effective temperature and gravity have been derived at each phase. From the

observations and model atmospheres the relative displacement curve R/R_{max} is determined. Slit spectra with a dispersion of 18 A/mm have been obtained and used to determine the radial-velocity curves of the metal lines, Hγ, Hδ, and H and K of Ca II. It is shown that differential motion exists in the atmospheres at all phases. Since the layer which one is observing changes during the cycle, because of changes in opacity, the velocity-curves cannot be interpreted literally, and integration of the velocity-curve does not yield the absolute displacement-curve, $R_{max} - R$. Therefore, the Wenselink-Baade method gives incorrect radii for RR Lyrae stars. It is shown, however, that between phases 0.40 and 0.85 it is possible to determine $R_{max} - R$ from the radial-velocity curve. The γ-velocity which is needed to determine $R_{max} - R$ cannot be obtained unambiguously, but a good estimate is possible. The mean radius of SU Dra is found to be 3.60×10^6 km, or 5.2 solar radii. The uncertainty is approximately 20%. The mean absolute visual magnitude is +0.8, with an uncertainty of roughly 0.4 if the absolute calibration of a Lyr is assumed correct. An alternative calibration of a Lyr yields an absolute visual magnitude which is 0.25 mag brighter. The difference in absolute magnitude of cluster-type variables can be determined with an accuracy of 0.2. The relationship between the effective temperature (actually θ_e) and B − V for SU Dra is given along with the same relationship for a hypothetical star which has no metallic lines.

252

California Inst. of Tech. Palomar Observatory, Pasadena.

[EFFECTIVE TEMPERATURE AND SURFACE GRAVITY OF WHITE DWARFS] Effektive Temperatur und Schwerebeschleunigung der Weissen Zwerge, by V. Weidemann. [1962] [30]p. incl. diagrs. tables, refs. (AFOSR-64-0282) (AF 49(638)21) AD 431493 Unclassified

Also published in Zeitschr. Astrophys., v. 57: 87-116, 1963.

Model atmospheres have been calculated in the white dwarf region (log g ≈ 8). For stars of spectral type DA the variety of H_γ-profiles as observed by Greenstein can be explained in terms of differences in effective temperature and surface gravity. The temperature scale is fixed by T_e (40 Eri B) = 13000°K (θ_e = 0.39). The surface gravity determined from the H_γ-profiles for 22 DA-stars is log g = 8.0 ± 0.5, corresponding to log R/R⊙ = −1.90 ± 0.15, M/M⊙ = 0.6 ± 0.3 for μ_e = 2. The results are in accordance with the observed colors. This can be demonstrated in a discussion of the U − B, B − V-diagram. The white dwarfs form 2 separate branches, spectral types DC and DB are located almost exactly on the black-body curve as given by ARP whereas a DA-sequence deviates from it parallel to the main sequence. The transition black-body to line-free star is considered and blanketing vectors are determined for log g = 8 and 4.4. The effective temperature of a white dwarf with given B − V agrees with that of a black-body rather than with that of a main sequence star of equal B−V. Within the limits H : He > 1 1000 at θ_e = 0.4 and > 1 /20 at θ_e = 0.3 the atmospheric abundance ratio H : He remains uncertain. Elements heavier than He can be ruled out as a main constituent. Radii and masses derived spectroscopically do not contradict μ_e = 2. Corresponding to the small scattering in g (or M and R) white dwarfs form a narrow sequence in the $M_{bol} - \theta_e$-diagram and seem to occur in a limited range of completely degenerate configurations only. (Contractor's abstract)

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[California Inst. of Tech. Palomar Observatory, Pasadena]

ABUNDANCES IN G DWARFS. VI. A SURVEY OF FIELD STARS (Abstract), by G. Wallerstein. [1962] [1]p. [AF 49(638)21] Unclassified

Published in Astrophys. Jour., v. 135: 310, Jan. 1962.

Data are presented for deriving the abundances of the elements in 21 field stars of very nearly solar type. Iron-to-hydrogen ratios are obtained from curves of growth for which the ionization temperatures are determined by considering both the excitation temperatures and the effective temperatures. The effective temperatures are derived both from the B−V colors (corrected for line blanketing) and the G−R colors of the 6-color photometry system. The abundance ratios of 10 other elements to iron are then derived. This material is combined with results for 13 other G dwarfs already published and is discussed from the point of view both of the nuclear reactions responsible for element building and of problems of galactic structure and stellar populations.

254

California Inst. of Tech. [Palomar Observatory] Pasadena.

OPTIMUM USE OF INTERSTELLAR REDDENING DATA TO OBTAIN INTRINSIC STELLAR LUMINOSITIES AND COLORS, by R. L. Wildey. [1962] [5]p. incl. diagrs. tables, refs. (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) [AF 49(638)21] Unclassified

Published in Astronom. Jour., v. 68: 190-194, Apr. 1963.

The data relating to the curvature and spectral-type dependence of reddening trajectories in the color-color diagram is discussed. By evaluating integrals over wavelength of the product of UBV response functions, stellar energy distributions, and the interstellar reddening law for various cosmic-dust masses, 2 graphs have been presented with which reddening corrections for stellar magnitudes and colors can be refined. One graph shows the intrinsic 2-color relation for class V stars and their reddening trajectories. The other graph shows $E_{(B-V)}$, $E_{(U-B)}$, and A_V vs the mass (arbitrary

units) per unit cross-sectional area of interstellar matter as 3 families of curves in the parameter $(B-V)_0$. The method of their use is described.

255

California Inst. of Tech. Palomar Observatory, Pasadena.

RADIO SOURCES CONTAINING PECULIAR ELLIPTICALS, by J. L. Greenstein. [1961] [6]p. incl. illus. diagrs. table, refs. (In cooperation with Carnegie Inst. of Washington, D. C.) [AF 49(638)21] Unclassified

Published in Astrophys. Jour., v. 135: 679-683, May 1962.

Radial velocities have been obtained for the double galaxies identifiable with the radio sources 3C442 and for the faint galaxy probably identifiable with Her A. The latter is a very distant system, with cz_0 = 46000 km sec; its radio luminosity is exceeded only by Cyg A and 3C295. Its diameter is outstandingly large, 350 kpc. Common peculiarities are weak to moderate [O II] emission in NGC 7237 (3C442) and in Her A. The optical diameters are large, and the gradient of surface brightness near the nucleus is low. The double galaxies in 3C278 and 3C442 are remarkably similar.

256

California Inst. of Tech. Palomar Observatory, Pasadena.

RECENT WORK ON ABUNDANCES IN PECULIAR A STARS (Abstract), by W. L. W. Sargent, L. Searle, and J. Jugaku. [1962] [2]p. (In cooperation with Mount Wilson Observatory, Pasadena) (AF 49(638)21) Unclassified

Presented at Victoria meeting of the Astronom. Soc. Pacific, June 21-22, 1962.

Published in Publ. Astronom. Soc. Pacific, v. 74. 408-409, Oct. 1962.

A prelimirary account is given of some results obtained from surveys of the abundances of certain elements in Ap stars. Emphasis has been placed upon the behavior of lines of the abundant light elements, H, He, C, N, O, Ne, Mg, and Si, since these elements can undergo appreciable abundance changes only by means of a relatively restricted number of nuclear reactions with one another. Also, in view of the possible abnormality in the atmospheric structures of these stars, study has been made of pairs of elements having lines that behave in an almost identical manner with changes in pressure and temperature. The work thus far has demonstrated that there are appreciable abundance variations among the Ap stars that are described very inadequately by the present system of classification.

257

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

RESEARCH IN SEISMOLOGY, by F. Press. Final rept. Aug. 31, 1962, 35p. (AFOSR-4148) (AF 49(638)-910) AD 287624 Unclassified

The research accomplishments of this contract are reviewed under the following major categories: instrumental seismology, numerical analysis and data handling, source mechanism determination, epicenter determination, wave propagation, and diagnostic aids for identifying earthquakes and explosions. Abstracts of 19 technical reports resulting from this research are included.

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

PROPAGATION OF ACOUSTIC-GRAVITY WAVES IN THE ATMOSPHERE, by F. Press and D. Harkrider. [1962] [20]p. incl. diagrs. refs. (AFOSR-J253) (AF 49(638)910) AD 400866 Unclassified

Also published in Jour. Geophys. Research, v. 67: 3889-3908, Sept. 1962.

Homogeneous wave guide theory is used to derive dispersion curves, vertical pressure distributions, and synthetic barograms for atmospheric waves. A complicated mode structure is found involving both gravity and acoustic waves. Various models of the atmosphere are studied to explore seasonal and geographic effects on pulse propagation. The influence of different zones in the atmosphere on the character of the barograms is studied. It is found that the first arriving waves are controlled by the properties of the lower atmospheric channel. Comparison of theoretical results and experimental data from large thermonuclear explosions is made in the time and frequency domains, and the following conclusions are reached: (1) the major features on barograms are due to disperson; (2) superposition of several modes is needed to explain observed features; (3) scatter of data outside the range permitted by extreme atmospheric models shows the influence of winds for A_1, and (4) wind effects and higher modes are less important for A_2 waves. A discussion is included on atmospheric terminations and how these affect disper sion curves.

259

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

A REINTERPRETATION OF PHASE VELOCITY DATA BASED ON THE GNOME TRAVEL TIME CURVES, by S. W. Smith. [1962] [5]p. incl. diagrs. (AFOSR-J254) (AF 49(638)910) AD 400865 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 52: 1031-1035, Dec. 1962.

Significant lateral variations in upper mantle velocities across the western U.S. were observed in the GNOME experiment. This makes necessary a reinterpretation of crustal thickness measurements made with the assumption that velocities in the various layers of the crust remain constant while their thickness changes. Four examples of the work of Ewing and Press have been reinterpreted. The crust is thinner (30 km) in the Basin and Range Province and thicker (55 km) under the Rocky Mountains than indicated by previous interpretations. (Contractor's abstract)

260

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

THE CALTECH DIGITAL SEISMOGRAPH, by W. F. Miller. [1962] [7]p. incl. diagrs. refs. (AF 49(638)-910) Unclassified

Published in Jour. Geophys. Research, v. 68: 841-847, Feb. 1, 1953.

A digital data logger has been constructed at the California Inst. of Tech. for recording the signals from long-period Press-Ewing seismometers. Three-component data are continuously digitized at the rate of 10 samples per sec with an 86-db dynamic range and stored on magnetic tape. With a tape speed of 0.5 in. sec, data for a 24-hr period may be recorded on one 10½-in. reel. An editing system is then used to select interesting events and convert them to a form compatible with the IBM 7090 computer for further reduction and analysis. (Contractor's abstract)

261

California Inst. of Tech. [Seismological Lab.] Pasadena.

THE DYNAMIC RESPONSE OF AN ELASTIC HALF-SPACE TO AN EXPLOSION IN A SPHERICAL CAVITY, by A. Ben-Menahem and A. Cisternas. [1962] [14]p. incl. diagr. table. (Contribution no. 1098) (AF 49-(638)910) Unclassified

Published in Jour. Math. and Phys., v. 42: 112-125, June 1963.

A semi-infinite region of homogeneous, isotropic elastic material contains a single spherical cavity of radius a with its center O at a distance h (> a) from the epicenter E (the point of the plane surface or the solid nearest to O). A wave motion which is symmetrical about the axis OE is excited by the application to the surface of the cavity of a uniform impulsive pressure, the plane surface of the solid being assumed to be traction-free. Expressions for the frequency spectra (i.e., the Fourier transforms with respect to time) of the radial and axial displacement components are derived, together with subsidiary equations from which various coefficients appearing in the spectra can be determined. The subsidiary equations are obtained in "best possible" form by expressing the conditions at the free surface in terms of evaluations at the epicenter. In the final section of the paper a method of successive approximations is developed for the case in which the wavelengths associated with the dilatational and rotational components of the disturbance are large compared with a. (Math. Rev. abstract)

262

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

LONG-PERIOD LOVE WAVES IN A HETEROGENEOUS SPHERICAL EARTH, by R. L. Kovach and D. L. Anderson. [1962] [13]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)910 and National Aeronautics and Space Administration) Unclassified

Published in Jour. Geophys. Research, v. 67: 5243-5255, Dec. 1962.

Periods of torsional eigenvibrations have been computed for heterogeneous spheres corresponding to a variety of earth models, and the periods of oscillation are used to calculate phase and group velocities for the fundamental and first higher modes of Love waves. A comparison is made between velocities computed for different spherical models and for equivalent flat earth structures. The comparison shows (1) that the effect of sphericity is more complicated for fundamental mode Love waves than for Rayleigh waves because of the efficient channeling of waves by low-velocity layers and (2) that the first higher Love mode is more affected by curvature than the fundamental mode. The variation with depth of the relative amplitude of the displacements indicates that the first higher Love mode for periods less than 90 sec is very sensitive to upper-mantle structure in the vicinity of the low-velocity zone. Comparison of the theoretical results with recent phase velocity and torsional oscillation data shows that a Gutenberg type of velocity structure is more satisfactory than either the Lehmann or Jeffreys structures. The use of consistent densities with the Gutenberg model, rather than Bullen A densities, has a small but significant effect on the calculated velocities. For periods greater than 200 sec the calculated phase velocities for various oceanic and continental structures are all within 2% of each other. The calculated group velocities are within 1½% of each other in the range 150 < T < 400 sec, thereby confirming experimental results. Dispersion measurements must therefore be made with precision if significant conclusions are to be inferred about details of earth structure. (Contractor's abstract)

263

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

STUDY OF THE EARTH'S CRUST IN SELECTED REGIONS OF THE WORLD. Final rept. Sept. 15, 1962, 63p. incl. diagrs. tables. (AFOSR-4803) (In cooperation with California U., Los Angeles) (AF 49(638)912) AD 407054 Unclassified

During the 2-yr period covered by this report, the Alps, the Western Mediterranean and a portion of Northeastern California were explored for the purpose

of obtaining detailed phase velocity measurements and for crustal study and interpretation. In these regions, a seismic network of 4 observatories was laid out in and around the area to be measured. Each of these stations was equipped with identical instrumentation so as to record uniformly distant teleseisms. As soon as sufficient events had been obtained to give an accurate determination of phase velocities at differing azimuths the network was then moved to a new location where similar measurements could be made. At all stations, the seismograph operated with a nominal 15 sec period and the galvanometer with a nominal 90 sec period. Recordings were made in duplicate; the original went to the United States for analysis and one copy was retained by the observatories. After the records had been examined for suitable events, digitized, and processed by computer, phase spectra at individual stations were determined by harmonic analysis and the resultant phase differences combined with proper instrument and station parameters to obtain phase velocities by the tripartite method.

264

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

PROCESSING OF SEISMIC DATA FROM AN AUTOMATIC DIGITAL RECORDER, by R. A. Phinney and S. W. Smith. [1962] [22]p. incl. diagrs. tables. (Contribution no. 1119) (AFOSR-4383) (AF AFOSR-63-25) AD 294914 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 549-562, Apr. 1963.

Data from a high-speed digital seismograph is given preliminary processing by a special tape-to-tape updating process which makes the information accessible to computer users. The routine nature of the data collection effort makes it necessary for all data to be labeled and entered into a library of digital seismograms. Emphasis is placed on location, corrections, and flagging of errors which occur during the recording and editing processes. Library data is stored on high density binary tapes with 2 data points packed into each computer word. Access to this data is by an interpretive loader which locates desired files by a search code and skips or inputs variable length blocks into memory. By allowing the loader to filter and decimate the data during input it is possible to bring many hr of low frequency data into a single memory domain with a minimum of waste effort. A collection of processing routines is being developed. These include: correction for seismograph response, orbital motion functions, energy computations, bandpass filtering for mode separation, etc. These must be coupled with an adequate graphical display device such as mechanical x-y plotter or a computer-controlled charactron tube.

265

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

GENERALIZED TWO-DIMENSIONAL MODEL SEISMOLOGY WITH APPLICATION TO ANISOTROPIC EARTH MODELS, by M. N. Toksoz and D. L. Anderson. Sept. 1962, 1v. incl. diagrs. table. (AFOSR-4748) (AF AFOSR-63-25) AD 408478 Unclassified

Also published in Jour. Geophys. Research, v. 68: 1121-1130, Feb. 15, 1963.

The theory of 2-dimensional seismic modeling is generalized to include the effect of anisotropy. The elastic coefficient matrix for a plate with orthorhombic symmetry is derived and is used to convert 3-dimensional anisotropic problems into corresponding 2-dimensional model problems. This is equivalent to replacing directional body velocities by the directional plate velocities. In addition to the application to seismic modeling, this can be considered a contribution to the basic theory of long waves in anisotropic plates. As such it has application to such problems as long waves in floating ice sheets. A model consisting of an anisotropic layer over an anisotropic half-space is constructed using a formica layer and a grooved aluminum plate. It is shown that rolled metal sheets can be made appreciably anisotropic by machining grooves in the surface. The experimental Rayleigh wave phase velocities are compared with the theoretical dispersion curves computed using isotropic and anisotropic theories. Two-layer circular models of the earth, 1 with an isotropic and the other with an anisotropic upper mantle, are fabricated, and a comparative study of body and surface waves is made. It is found that the relative effect of anisotropy is greater on surface waves than on body waves.

266

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

PRECISION DETERMINATION OF FOCAL DEPTHS AND EPICENTERS OF LOCAL SHOCKS IN CALIFORNIA, by A. Cisternas. [1962] [16]p. incl. diagrs. tables, refs. (Contribution no. 1142) (AFOSR-5360) (AF AFOSR-63-25) AD 400168 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 1075-1083, Oct. 1963.

A program for the location of hypocenters of local shocks by means of an electronic digital computer is described. The P times are corrected for variations in crustal structure to get precision in the determination of depth. An estimate of the accuracy of the method is given for some particular cases. Application of the program to the Kern County series of aftershocks, provides a clearer picture of tetonic mechanism of the White Wolf fault. A future extension of the program to process and correct data automatically is also described. (Contractor's abstract)

267

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

A STUDY OF DIAGNOSTIC TECHNIQUES FOR IDENTIFYING EARTHQUAKES, by F. Press, G. Dewart, and R. Gilman. [1962] [20]p. incl. diagrs.

tables, refs. (Contribution no. 1128) (AF AFOSR-63-25) AD 406360 Unclassified

Also published in Jour. Geophys. Research v 68: 2909-2928, May 15, 1963.

Several diagnostic techniques are examined for identifying earthquakes as events distinct from possible underground nuclear explosions. It is found that the typical or 'mean' earthquake differs in a statistically significant way from the 'mean' explosion for most of the techniques. Due to the variability of earthquake signatures, many earthquake parameters fall within the range observed for explosions. Preliminary studies of several diagnostic methods are presented. The purpose is to make a preliminary study of these techniques subject to the obvious limitations of small samples and restricted geographic distribution of sources and detectors. Although most of the techniques discussed are pertinent to a monitoring system with stations on the same continental mass as the seismic source, discovery of differences between earthquake and explosion signatures for this case encourages one to search for other differences applicable when the sources and stations are more widely separated. (Contractor's abstract)

268

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

SURFACE WAVES ON A SPHERICAL EARTH. I. UPPER MANTLE STRUCTURE FROM LOVE WAVES, by D. L. Anderson and M. N. Toksoz. [1962] [18]p. incl. diagrs. tables, refs. (Contribution no. 1144) (AF AFOSR-63-25) AD 299060 Unclassified

Also published in Jour. Geophys. Research, v. 68: 3483-3500, June 1, 1963.

The problem of free oscillations of a heterogeneous sphere is reformulated in terms of dispersion over a plane half-space composed of anisotropic layers having a superposed velocity gradient. This transforms the standing wave discrete spectrum to a traveling-wave continuous spectrum and considerably simplifies the analysis of surface waves on a sphere. Minor modifications make it possible to use any Love wave computer program to compute dispersion on a sphere. Results of the method are compared with those obtained from numerical integration of the exact equations of motion. Agreement is generally better than 0.06%. Dispersion for the fundamental and first 7 to 8 higher Love modes is presented for a continental and an oceanic path. The oscillatory nature of the group velocity curves becomes more pronounced when a velocity reversal takes place. Calculations of higher-mode group velocity structure and displacement illustrate the mechanism of propagation of the S_σ wave. By successive modifications of a previously developed mantle structure, a new suboceanic m model is determined which satisfies Love wave and torsional oscillation data.

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

GENERATION OF SEISMIC WAVES BY UNDERGROUND EXPLOSIONS AND THE COLLAPSE OF CAVITIES, by S. W. Smith. [1962] [7]p. incl diagrs refs. (AF AFOSR-63-26) Unclassified

Published in Jour. Geophys. Research, v. 68: 1477-1483, Mar. 1, 1963.

The occurrence of large collapse features associated with contained underground nuclear tests in alluvial material provides an unusual opportunity to study the effect of source geometry and time history. The explosion is represented by a pressure pulse applied to a buried spherical cavity, and a collapse by a point force normal to the surface. If the time duration for these sources is 0.16 sec and 4 sec, respectively, the resulting spectral ratio for Rayleigh waves is consistent with the experimental data in the frequency range 0.5 to 3.0 cps. The spectral ratios for SH and SV waves indicate that the SH waves are not generated by near-source phenomena such as movement along joints, but by elastic wave conversion within a few wavelengths of the source.

270

California U., Berkeley.

PROCEEDINGS OF THE FOURTH U.S. NATIONAL CONGRESS OF APPLIED MECHANICS, VOLUMES 1 AND 2, CALIFORNIA U., BERKELEY, June 18-21, 1962, ed. by R. M. Rosenberg, M. V. Barton and others. New York, American Society of Mechanical Engineers, 1962, 2v. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-63-10], Army Research Office (Durham), National Committee on Theoretical and Applied Mechanics, Office of Naval Research and others) Unclassified

The proceedings comprise 4 invited general lectures and complete texts of 153 technical papers presented at the congress. The latter are grouped by subject matter into 4 broad categories: (1) dynamics, vibrations, and elastic waves; (2) elasticity and elastic structures; (3) plasticity, viscoelastic flow, and fracture; and (4) fluid flow, aerodynamics, and heat transfer. Within each category the papers are arranged alphabetically by author. The affiliation and postal address of each author is given.

271

California U. [Center for Human Learning] Berkeley.

FIRST CALIFORNIA CONFERENCE ON VERBAL LEARNING AND VERBAL BEHAVIOR, by B. J. Underwood and L. Postman. [1962] [9]p. (AFOSR-J168) [AF AFOSR-62-389] Unclassified

Also published in Jour. Verbal Learning and Verbal Behavior, v. 1: 312-320, Jan. 1963.

For abstract see item no. 272, Vol. VI.

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California U. [Center for Human Learning] Berkeley.

FIRST CALIFORNIA CONFERENCE ON VERBAL LEARNING AND VERBAL BEHAVIOR, by B. J. Underwood and L. Postman. [1962] [9]p. (AFOSR-66-2017) [AF AFOSR-62-389] AD 643048 Unclassified

Also published in Jour. Verbal Learning and Verbal Behavior, v. 1: 312-320, Jan. 1963.

This is a summary report of papers presented by the 9 participants at the research conference on verbal learning and verbal behavior held from June 12 to June 17, 1962 at the California U. Conference Center at Lake Arrowhead. The papers describe the current status of research of the participants on various human learning problems.

273

California U. Dept. of Chemistry, Berkeley.

THE PROMISE AND PROBLEMS OF THE MATRIX ISOLATION METHOD FOR SPECTROSCOPIC STUDIES, by G. C. Pimentel. [1958] [3]p. (AFOSR-4308) (AF 49(638)1) Unclassified

Also published in Spectrochim. Acta, v. 12: 94-96, Mar.-Apr. 1958.

For abstract see item no. CAL. 07:008, Vol. II.

274

California U. Dept. of Chemistry, Berkeley.

APPLICATION OF THE MOLECULAR ORBITAL ω-TECHNIQUE TO AROMATIC SUBSTITUTION, by A. Streitwieser, Jr., J. I. Brauman, and J. B. Bush. [1962] [13]p. incl. diagrs. tables, refs. (AFOSR-65-0213) (AF 49(638)105) AD 611290 Unclassified

Also published in Tetrahedron, v. 19, suppl. 2: 379-391, 1963.

The ω-technique of the simple molecular orbital method is found to provide a reasonably good correlation with the available experimental data on partial rate factors of nitration of alternant and non-alternant polycyclic aromatic hydrocarbons. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

PARTIAL RATE FACTORS FOR NITRATION OF FLUORANTHENE, by A. Streitwieser, Jr. and R. C. Fahey. [1962] [4]p. incl. diagr. tables, refs. (AFOSR-65-0215) (AF 49(638)105) AD 611348 Unclassified

Also published in Jour. Org. Chem., v. 27: 2352-2355, July 1962.

Nitration of fluoranthene gave the following partial rate factors relative to a 1-naphthalene position: in acetic anhydride at 0°C: 1, 0.7; 3, 2.9; 7, 1.2; 8, 1.8; in acetic acid at 50 °C: 1, 0.3; 3, 8.1; 7.0.6; 8, 2.7. The 7-mononitro isomer was obtained for the first time.

276

California U. Dept. of Chemistry, Berkeley.

REACTION OF OXYGEN ATOMS WITH ACETYLENE TO FORM KETENE, by I. Haller and G. C. Pimentel. [1962] 10p. incl. diagrs, tables, refs. (AFOSR-2811) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)944 and American Petroleum Inst.) AD 276563 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 2855-2857, Aug. 5, 1962.

Nitrous oxide, N_2O, was photolyzed at 20°K in solid argon containing acetylene, C_2H_2, or a mixture of C_2D_2 and C_2HD. The photolysis source was a xenon resonance lamp emitting mainly at 1470A. This radiation produces ground state oxygen atoms. Infrared spectra showed that reaction occurred with C_2H_2 to produce absorption at 2143 cm^{-1} and with the deuterated acetylenes to produce absorptions at 2142 and 2117 cm^{-1}. The absorptions are assigned to ketene, thus showing that ground state oxygen atoms can react with acetylene to produce ketene. The activation energy for this reaction is below 8.1 kcal/mol. (Contractor's abstract)

277

California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTROSCOPIC STUDY OF THE PHOTOLYSIS OF HN_3 IN SOLID CO_2, by D. E. Milligan, M. E. Jacox and others. June 1962 [24]p. incl. diagrs. tables, refs. (AFOSR-2987) (In cooperation with Mellon Inst., Pittsburgh, Pa.) (AF 49(638)542 and AF 49(638)944) AD 282779 Unclassified

Infrared studies were carried out on the photolysis of HN_3 and DN_3 in CO_2 matrices at 20 and 53°K. HNO and DNO were identified as products of the reaction of NH and ND with CO_2. The presence of HNO was confirmed by the detection of absorption at 7600, 7100,

and 6850A in the visible spectral region. Evidence has also been obtained for the production of a 1:1 compound between NH (ND) and CO_2. Several possible structures for this species are discussed. (Contractor's abstract)

278

California U. Dept. of Chemistry, Berkeley.

THE INFRARED SPECTRUM OF ICE: TEMPERATURE DEPENDENCE OF THE HYDROGEN BOND POTENTIAL FUNCTION, by R. Zimmermann and G. C. Pimentel. July 1962, 26p. incl. diagrs. tables, refs. (AFOSR-3670) (AF 49(638)944) AD 284401 Unclassified

The infrared spectrum of ice was studied in the spectral region from 2500 to 200 cm^{-1} and over the temperature range -180 to -20°C. Absorption near 220 cm^{-1} was detected. Infrared spectra of H_2O-D_2O ice mixtures show that crystal splittings are not responsible for the observed frequency of the bending mode of H_2O in ice. Two temperature effects are noted, one an irreversible change evidently caused by annealing. In addition the absorptions near 1600, 800, and 220 cm^{-1} of annealed ice shift with temperature reversibly. A simple normal co-ordinate analysis provides estimates of the potential function for stretching and bending the hydrogen bonds, about 0.16×10^5 and 0.09×10^5 dynes/cm respectively.

279

California U. Dept. of Chemistry, Berkeley.

ISOMERIZATION OF NITROUS ACID: AN INFRARED PHOTOCHEMICAL REACTION, by R. T. Hall and G. G. Pimentel. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-64-0575) (AF 49(638)944) AD 434306 Unclassified

Also published in Jour. Chem. Phys., v. 38: 1889-1897, Apr. 15, 1963.

Nitrous and deuteronitrous acid suspended in nitrogen matrices at 20°K isomerize when illuminated with infrared light. Kinetic studies indicate that both the cis to trans and the trans to cis isomerizations occur. Filter studies show that a narrow range of frequencies is responsible, 3650-3200 cm^{-1} for HONO and 4100-3500 cm^{-1} for DONO. An isomerization mechanism is proposed that involves a highly efficient intramolecular transfer of energy between vibrational modes. The height of the potential barrier to isomerization is estimated to be 9.7 ± 0.7 kcal/mol in the matrix and 8.7 ± 1 kcal/mol for gaseous HONO. Comparison to methyl nitrite suggests that the bondings in these 2 molecules are quite similar and that the reported structure of methyl nitrite is incorrect.

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California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTRUM AND VIBRATIONAL POTENTIAL FUNCTION OF KETENE AND THE DEUTERATED KETENES, by C. B. Moore and G. C. Pimentel. [1962] [14]p. (AFOSR-64-0685) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)944, National Science Foundation, and Petroleum Research Fund) AD 436496 Unclassified

Also published in Jour. Chem. Phys., v. 38: 2816-2829, June 15, 1963.

Infrared spectra of solid ketene and ketene in argon revealed a new fundamental at lower frequency (CH_2CO, 438 cm^{-1}; CD_2CO, 371 cm^{-1}; CHDCO, 398 cm^{-1}) than any previously reported. These spectra and additional gas-phase spectra provide a basis for a reassignment of the vibrational spectrum. The vibrational potential function, centrifugal distortion constants, coriolis coupling constants, and thermodynamic properties of ketene have been calculated. The out-of-plane hydrogen bending force constant is found to be surprisingly low, about one-third of that for ethylene. In addition, the analysis of the rotational structure of several perpendicular bands yields improved estimates of the A moment of inertia and hence of the HCH angle (122.3°) and the C-H bond length (1.079A) of ketene. (Contractor's abstract)

281

California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTRAL PERTURBATIONS IN MATRIX EXPERIMENTS, by G. C. Pimentel. [1962] [2]p. [AF 49(638)944] Unclassified

Published in Proc. Internat'l. Symposium on Molecular Structure and Spectroscopy, Tokyo (Japan) (Sept. 10-14, 1962), Japan, Science Council, Dec. 1962, p. B 408-1 - B 408-2.

Some types of matrix studies are impeded by lack of understanding of the effect of the matrix upon the infrared spectrum. In the present paper a number of studies are considered in which the spectra of stable molecules in simple matrices are investigated. Matrix-induced frequency shifts and multiplet splittings are also considered.

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. VI. METALATION OF NORBORNADIENE WITH BUTYLLITHIUM, by A. Streitwieser, Jr. and R. A. Caldwell. [1962] [2]p. (AFOSR-65-0221) (AF AFOSR-62-175) AD 611600 Unclassified

Also published in Jour. Org. Chem., v. 27: 3360-3361, Sept. 1962.

Experiments were performed in order to obtain evidence relating to the relative acidities of the various hydrogens in norbornadiene. Of particular interest is the relative mobility of the 7-hydrogens (bridge). Norbornadiene was allowed to react with excess butyllithium in refluxing ether-heptane. After quenching with deuterium oxide, the recovered norbornadiene was studied by infrared and nmr. The results demonstrate no significant exchange of bridge hydrogens but do show almost complete metallation of a vinyl position. The availability of norbornadiene makes this procedure acceptable as a preparation of norbornadiene-2-d. In this type of metallation exchange reaction, the vinyl hydrogens of norbornene are clearly much less acidic than those of norbornadiene. One possible explanation is that each double bond in norbornadiene exerts an important inductive effect to enhance the acidity of the other.

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. VII. RATES OF EXCHANGE OF POLYCYCLIC METHYLARENE-α-d's WITH LITHIUM CYCLOHEXYLAMIDE, by A. Streitwieser, Jr. and W. C. Langworthy. [1962] [5]p. incl. diagrs. tables, refs. (AFOSR-65-0222) (AF 49-(638)105 and AF AFOSR-62-175) AD 611343
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1757-1761, June 20, 1963.

Rates of exchange are reported for various deuteriomethyl derivatives of naphthalene, phenanthrene, anthracene, pyrene and fluoranthene with lithium cyclohexylamide in cyclohexylamine at 49.9°. The relative rates are discussed with reference to the stabilities of corresponding arylmethyl anions and are compared with those of related carbonium ion reactions.

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. VIII. AN HMO EXAMINATION OF EXCHANGE RATES OF METHYLARENE-α-d's WITH LITHIUM CYCLOHEXYLAMIDE, by A. Streitwieser, Jr., W. C. Langworthy, and J. I. Brauman. [1962] [3]p. incl. diagr. table, refs. (AFOSR-65-0223) (AF 49(638)105 and AF AFOSR-62-175) AD 611455 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1761-1763, June 20, 1963.

The HMO (Huckel Molecular Orbital) method is shown to provide a fair correlation of the experimental results reported in the preceding paper. Application of MO theory suggests that the McEwen scale of hydrocarbon acidities is seriously compressed and new values are tentatively assigned.

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. X. EXCHANGE RATES OF RING-SUBSTITUTED TOLUENE-α-t's WITH LITHIUM CYCLOHEXYLAMIDE IN CYCLOHEXYLAMINE, by A. Streitwieser, Jr. and H. F. Koch. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0224) (AF AFOSR-62-175) AD 611602
Unclassified

Presented at meeting of the Org. Chem. Div. of the Amer. Chem. Soc., Atlantic City, N. J., Sept. 9-14, 1962.

Abstract published in 142nd meeting of the Amer. Chem. Soc. Abstracts of Papers, 1962, p. 2-Q.

Also published in Jour. Amer. Chem. Soc., v. 86: 404-409, Feb. 5, 1964.

Relative exchange rates at 50° toward lithium cyclohexylamide of substituted α-tritiotoluenes and some α-deuteriotoluenes are: H, 1.00; o-CH_3, 0.60, m-CH_3, 0.60; p-CH_3, 0.31; o-$CH(CH_3)_2$, 0.41; m-$CH(CH_3)_2$, 0.61; p-$CH(CH_3)_2$, 0.29; o-F, 12; m-F, 22; p-F, 0.73; m-CF_3, 60; p-CF_3, ~180; m-OCH_3, 2.1; p-OCH_3, 0.09. These values fit a Hammett $\sigma\rho$ correlation with $\rho = 4.0$, a value higher than that for phenol or anilinium dissociations. The extension to polycyclic systems is discussed. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

A MOLECULAR ORBITAL STUDY OF THE POLAROGRAPHIC REDUCTION IN DIMETHYLFORMAMIDE OF UNSUBSTITUTED AND METHYL-SUBSTITUTED AROMATIC HYDROCARBONS, by A. Streitwieser, Jr. and I. Schwager. [1962] [5]p. diagrs. tables, refs. (AFOSR-65-0226) (AF AFOSR-62-175) AD 611604
Unclassified

Also published in Jour. Phys. Chem., v. 66: 2316-2320, Dec. 1962.

The half-wave potentials of a number of aromatic compounds have been determined and are found to fit the same type of correlation with the energies of the lowest vacant molecular orbitals in the HMO approximation established in other solvents. The deviation of biphenylene from this correlation can be accounted for in terms of "long bonds" but this explanation fails when applied to 2,3-benzobiphenylene. Azulene and acepleiadylene do not obey the simple theory. The effect of methyl substituents is accounted for successfully in terms of a combination of conjugative (hyperconjugation) and inductive influences. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

MATRIX TECHNIQUE AND ITS APPLICATION IN THE FIELD OF CHEMICAL PHYSICS, by G. C. Pimentel. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-J665) [AF AFOSR-63-332] AD 415403 Unclassified

Also published in Pure and Appl. Chem., v. 4: 61-70, 1962.

Current applications of the matrix isolation technique to studies of infrared spectroscopy are reviewed. This method involves the spectroscopic detection of a molecular species dispersed in a spectroscopically distinct host matrix, either a crystal or a glass. The purposes are to obtain a particular set of controlled environmental conditions and/or accumulation of a suitable amount of an otherwise inaccessible species. The matrix materials are of 3 classes: ionic cyrstals, inert gas crystals, and molecular solids. Preparation of matrix samples and illustrative examples of their applications are given. A list of 20 references is included.

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California U. [Dept. of Mathematics] Berkeley.

ON THE COHOMOLOGY GROUPS OF THE CLASSIFYING SPACE FOR THE STABLE SPINOR GROUPS, by E. Thomas. [1962] [13]p. (AFOSR-3348) [AF 49-(638)-79] Unclassified

Also published in Bol. Soc. Mat. Mex., v. 7: 57-69, 1962.

Let Spin = lim Spin (n) be the infinite spinor group, B_{spin} its classifying space. The author determines the mod 2 and integral cohomology of B_{spin}. Let ν: $B_{spin} \to B_{so}$ be the natural map induced by the coverings Spin (n) $\to$ SO(n), and let $W_i \in H^i(B_{so}; Z_2)$, $P_i \in H^{4i}(B_{so}; Z)$ be the Stiefel-Whitney and Pontrjagin classes. Then the results are the following: (1) $H^*(B_{spin}; Z_2)$ is a polynomial algebra on generators $\nu^* W_i (i \neq 2^r + 1)$; (2) $H^*(B_{spin}; Z)$ is the direct sum of a polynomial algebra on generators $\nu^* P_i$ $(i \neq 2^r)$ and a torsion group T; moreover, 2T = 0. The proof of (1) follows fairly easily from the fibration $B_{Z_2} \to B_{spin} \to B_{so}$ and standard consideration of Steenrod squares. The proof of (2) is considerably more complicated and involves, among other things, the Pontrjagin square. (Math. Rev., abstract)

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[California U. Dept. of Mathematics, Berkeley]

AXIOMS FOR THE GENERALIZED PONTRYAGIN COHOMOLOGY OPERATIONS, by W. Browder and E. Thomas. [1961] [6]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)79] and National Science Foundation) Unclassified

Published in Quart. Jour. Math. (Oxford), v. 13: 55-60, Mar. 1962.

It is shown that the generalized Pontryagin operation

$$C: H^{2n}(X; Z_p^r) \to H^{2pn}(X; Z_p^{r+1})$$

is characterized by its known properties; these include behavior with respect to coefficient homomorphisms, behavior under suspension, and a formula giving $C(u_1 + u_2) - C(u_1) - C(u_2)$. The proof proceeds via Eilenberg-Mac Lane spaces and their cohomology groups $H^*(\pi, n; G)$, but it is so arranged that the only facts which need to be quoted are those for $G = Z_p$ and $G = Z_p^2$. The corresponding results for $p = 2$ are stated.

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California U. [Dept. of Mathematics] Berkeley.

THE DEFINITION OF FIELD OF DEFINITION, by M. Rosenlicht. [1962] [8]p. (AFOSR-J127) [AF 49-(638)-603] AD 400449 Unclassified

Also published in Bol. Soc. Mat. Mex., v. 7: 39-46, 1962.

Discussing abstract algebraic varieties and their fields of definition, Weil restricted his attention to those which are irreducible. The author, still using Weil's language and methods, extends the definition of the concept of "rationality over a field k" to (possibly) reducible algebraic sets. As an application, he considers the case of algebraic groups and shows that his concept of rationality is compatible with forming quotient groups and certain quotient spaces. Although the author avowedly avoids from the outset "the vast generality of Grothendieck's system", the reviewer believes that his definitions are most easily expressed in that system. By an "algebraic set V over k", the author means a reduced noetherian scheme over k, locally embeddable in affine n-space over k. For V to be "rational over k" means to be geometrically reduced—that is, V remains reduced after any base-field extension.

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California U. Dept. of Mathematics, Berkeley.

DIVERGENCE OF APPROXIMATING POLYNOMIALS, by P. C. Curtis, Jr. [1962] [5]p. (AF 49(638)859) Unclassified

Published in Proc. Amer. Math. Soc., v. 14: 713-717, Oct. 1963.

Let f be a continuous function on the circle and let F_n be a set of $m_n (m_n \geq 2n + 1)$ points equally spaced on the circle. Let $p_n(f, x)$ be the trigonometric polynomial of order n which approximates f best on F_n in the sense of least squares. For each f let P_n be the operator defined by $(P_n f)(x) = p_n(f, x)$. The author investigates when this sequence fails to converge at individual points. His main results are that for each choice of sets F_n the set of points of divergence on the circle is the complement of a set of the first category. And if $\lim \sup_n m_n n > \pi \sqrt{2}$ then every point is a point of divergence. An example is given to show that some growth condition on m_n is necessary to insure divergence at every point. (Math. Rev. abstract)

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California U. [Dept. of Mathematics] Berkeley.

NON-ATOMIC MEASURES ON COMPACT HAUSDORFF SPACES, by M. Hasumi and G. L. Seever. 1962, 9p. (AFOSR-4899) (AF AFOSR-62-140) AD 414047 Unclassified

Rudin has proved that a compact Hausdorff space without perfect subsets is also without non-zero, non-atomic, regular Borel measures. Theorems 1 and 2 of this report state the equivalence of these conditions show further relationship between perfect subsets and non-atomic measures. Dixmier has shown the existence of an infinite Stonian space without normal measures (regular Borel measures which vanish on meager Borel sets). The question arises as to whether an infinite Stonian space has non-zero, non-atomic regular Borel measures. The answer to this is shown in the present note to be affirmative and it is further shown that the dual of a Banach space with the extension property has the lifting property if it is finite-dimensional.

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California U. [Dept. of Mathematics] Berkeley.

HOMOMORPHISMS OF NON-COMMUTATIVE *-ALGEBRAS, by S. B. Cleveland. [1962] [13]p. incl. refs. (AFOSR-64-1618) (AF AFOSR-62-140) AD 446885 Unclassified

Also published in Pacific Jour. Math., v. 13: 1097-1109, 1963.

Let A and B be Banach algebras and N a homomorphism of A into B. This paper is a study of the continuity properties of N which depend only on the structure of A; B is completely arbitrary. The algebras considered are non-commutative.

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California U. [Dept. of Mathematics] Berkeley.

HOMOTOPY-ABELIAN TOPOLOGICAL GROUPS, by I. James and E. Thomas. [1962] [4]p. (AFOSR-J444) [AF AFOSR-62-291] Unclassified

Also published in Topology, v. 1: 237-240, 1962.

The authors say that a topological group G is homotpy-abelian if the commutator map of G x G into G is nul-homotopic. In this note their techniques are combined with a result of Browder (Ann. Math., v. 76: 9-17, 1962) to prove the following. Let G be a countable connected CW-complex with finitely generated singular homology. If G is a homotopy-abelian topological group, then G has the homotopy type of a torus. In particular, if G is simply connected, as well as homotopy-abelian, then G is contractible. (Math. Rev. abstract)

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California U. [Dept. of Mathematics] Berkeley.

ON THE MOD 2 COHOMOLOGY OF CERTAIN H-SPACES, by E. Thomas. [1962] [9]p. (AFOSR-J445) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-291 and John Simon Guggenheim Foundation) AD 407114 Unclassified

Also published in Comment. Math. Helv., v. 37: 132-140, 1962.

Let X be an H-space whose integral (singular) cohomology groups are all finitely generated, and whose mod 2 cohomology is a primitively generated Hopf algebra of finite dimension. The author shows that in this case, the least positive integer ν such that $H^\nu(X; Z_2) \neq 0$ must be 1, 3, 7, or 15, or else X is acyclic. Furthermore, if X has no 2- torsion, then the value 15 cannot occur. The technique involved is an examination of the behavior of the Steenrod squares in the X-projective plane P_2X, using the Adams secondary cohomology operations decomposing Sq^{2k}, and the fact that the cohomology of P_2X is the direct sum of a truncated polynomial algebra of height 3, and an ideal. (Math. Rev. abstract)

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[California U. Dept. of Mathematics, Berkeley]

NILPOTENT LINEAR ALGEBRAIC GROUPS, by M. Rosenlicht. [1962] [20]p. (AFOSR-64-2275) [AF AFOSR-63-121] AD 452408 Unclassified

Presented at Seminar on Algebra, Geometry, and Topology, Rome (Italy), Dec. 17-19, 1962.

Also published in Seminari dell' Istituto Nazionale di Alta Matematica, 1962-63, v. 1: 133-152, 1964.

This paper gives an elementary introduction to some

basic notions and facts about linear algebraic groups and some results on nilpotent or locally nilpotent linear group. (Math. Rev. abstract)

297

California U. [Dept. of Mathematics] Berkeley.

ON THE PROJECTIVE PLANE OF AN H-SPACE, by W. Browder and E. Thomas. [1962] [1]p. incl. refs. (AFOSR-J1535) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-336, John Simon Guggenheim Foundation, and National Science Foundation) AD 427850 Unclassified

Also published in Illinois Jour. Math., v. 7: 492-501, Sept. 1963.

Suppose that X is an H-space, that is, X has a continuous multiplication with unit. One then may not be able to define a classifying space B_X, but Stasheff has defined the projective plane of X, P_2X, which has the homotopy type of the space B_2 in case X is actually a group. The relationship between the cohomology of X and that of P_2X is discussed.

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[California U. Dept. of Physics, Berkeley]

SPIN-WAVE INSTABILITY AND PREMATURE SATURATION IN ANTIFERROMAGNETIC RESONANCE, by A. J. Heeger and P. Pincus. [1962] [3]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18-(603)46] and National Science Foundation) Unclassified

Published in Phys. Rev. Ltrs., v. 10: 53-55, Jan. 15, 1963.

A semiclassical theory of spin-wave instability in antiferromagnetic resonance is developed. The calculation is valid both for simple antiferromagnets and for canted systems when the canting is due either to single ion magnetocrystalline anisotropy or anisotropic exchange. The nonlinear terms leading to the instability are found to originate in the anisotropy and exchange energies. The critical radio frequency for the onset of instability is calculated and in general is given by $h_c = 4\Delta H_0 (\gamma \Delta H_k \omega_0)^{1/2}$, where ΔH_0 and ΔH_k are respectively the uniform mode and spin-wave linewidths; and ω_0 is the zero-field antiferromagnetic resonance frequency. Experimental evidence for the existence of spin-wave instability is attributed to the onset of spin-wave instability. A new technique for the measurement of spin-wave linewidths is described. This technique, which is based on the response of the resonant system to amplitude modulated microwave power, yields results in agreement with the instability theory. The spin-wave linewidth as determined by these experiments is approximately 3 orders of magnitude narrower than the linewidth of the uniform mode, indicating that the broadening mechanisms are grossly different in the 2 cases.

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California U. [Dept. of Physics] Berkeley.

SEMIEMPIRICAL MODEL OF THE INTERPLANETARY MEDIUM, by J. C. Brandt and R. W. Michie. [1962] [2]p. incl. diagr., refs. (AFOSR-3649) (AF 49(638)299) Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 195-196, Mar. 1, 1962.

A semiempirical model of the interplanetary medium extending from the corona to about 5 astronomical units is presented. Graphs giving the variation of the expansion velocity and the electron density with the distance are plotted. The model presented is consistent with satellite observations showing a considerable fine structure in the interplanetary medium.

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California U. [Dept. of Physics] Berkeley.

ON THE DISTRIBUTION OF HIGH ENERGY STARS IN SPHERICAL STELLAR SYSTEMS, by R. W. Michie. [1962] [26]p. incl. diagr. (AFOSR-404?) (AF 49(638)-299) AD 290671 Unclassified

Abstract published in Quart. Jour. Roy. Astronom. Soc., v. 4: 323, Sept. 1963.

Also published in Monthly Notices Roy. Astronom. Soc., v. 125: 127-139, 1963.

A distribution function $f(r, v, u; t)$ for isolated spherical stellar systems is obtained from the Boltzmann equation with encounters described by the Fokker-Planck equation. The distribution function is believed to correspond rather closely to actual stellar systems since it is obtained from the Boltzmann equation, the potential is obtained from Poisson's equation, and the stellar orbits are not assumed to be isotropic everywhere but rather are more radial at greater distances from the center. The importance of a careful analysis in the region of phase space at and near the energy of escape is emphasized. In this region, it is shown that the velocity space flux vector is constant, and it is this constancy which allows a solution for f. The distribution of high energy stars is depopulated for (1) those stars whose mass is small compared to the average stellar mass, (2) regions close to the center of the system, and (3) large values of the model parameter C. It is proposed that the method of analysis presented may be used for obtaining a distribution function for rotating stellar systems. (Contractor's abstract)

301

California U. [Dept. of Physics] Berkeley.

INTERPLANETARY GAS. VII. A SEMIEMPIRICAL MODEL, by J. C. Brandt and R. W. Michie. [1962] [20]p. incl. diagrs. refs. (AFOSR-4048) (AF 49(638)-299) AD 290672 Unclassified

Also published in Astrophys. Jour., v. 136: 1023-1036, Nov. 1962.

A theoretical expression is obtained connecting parameters in the solar wind near the orbit of earth with parameters in the inner corona. A model similar to the empirical model presented recently (Brandt 1962) is found to be reasonably consistent with the theoretical expression. Near the orbit of earth, an expansion velocity of 200-400 km. sec and a mean electron density of 1-5. cm^3 are thought to be probable.

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California U. Dept. of Physics, Berkeley.

ANALYTICITY IN COMPLEX ANGULAR MOMENTUM OF THE RELATIVISTIC S-MATRIX, by A. O. Barut and D. E. Zwanziger. [1962] 9p. incl. refs. (AFOSR-2400) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Alfred P. Sloan Foundation) Unclassified

Also published in Phys. Rev., v. 127: 974-977, Aug. 1, 1962. (Title varies)

The purpose of this work is to establish, on the basis of unitarity and the Mandelstam representation, the analyticity and threshold behavior of the positions and residues of the poles of the scattering amplitude in angular momentum as a function of energy, separate the right and left cuts of the partial wave amplitude for complex ℓ, and extend, in a model theory in which elastic unitarity holds, the domain of analyticity in the ℓ plane to the region $Re\ell > 1$. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

THEORETICAL PHYSICS OF ELEMENTARY PARTICLES, by R. Karplus. Final rept. Apr. 1, 1958-May 31, 1962, 4p. (AFOSR-2780) (AF 49(638)327) AD 286724 Unclassified

A list is given of articles published during 50 months' work in the theoretical physics of elementary particles. The bulk of the work was concerned with the treatment of the functions used to describe reactions between elementary particles as analytic functions of complex energy and angle variables. Two other types of problems on which work was done were the study of strong and weak interactions of elementary particles to interpret experimental results obtained with the large accelerators and the peculiar effects of interactions among elementary particles in systems containing many such particles.

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California U. Dept. of Physics, Berkeley.

COMPLEX ANGULAR MOMENTUM IN RELATIVISTIC S-MATRIX THEORY, by A. O. Barut and D. E. Zwanziger. [1962] [4]p. incl. refs. (AFOSR-J338) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Alfred P. Sloan Foundation) AD 408059 Unclassified

Also published in Phys. Rev., v. 127: 974-977, Aug. 1, 1962.

For abstract see item no. 302, Vol. VI.

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California U. [Dept. of Physics] Berkeley.

ANALYTIC PROPERTIES IN ANGULAR MOMENTUM OF THE RELATIVISTIC S MATRIX (Abstract), by A. O. Barut and D. E. Zwanziger. [1962][1]p. [AF 49-(638)327] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 300, Apr. 23, 1962.

From the Mandelstam representation, an analytic continuation in angular momentum ℓ is defined. The kinematical cuts are explicitly separated so that the amplitude has the form

$$A(q^2, \ell) = (q^2 + \mu^2)^{\ell} q^{2\ell} \frac{\cos \pi\ell}{Y(q^2, \ell) \cdot \exp[(\ell + \tfrac{1}{2})\ln(-q^2)]},$$

where $Y(q^2, \ell)$ is a real analytic function of q^2 and ℓ with a cut from $q^2 = -\infty$ to $q^2 = -\mu^2$ only. Thus, $A/q^{2\ell}$ itself is a real analytic function in q^2 and ℓ. From this expression, the analytic properties of the positions $\alpha_n(q^2)$ and the residues $\beta_n(q^2)$ of the poles in the angular-momentum plane (Regge poles) are obtained. The quantities $\sigma_n(q^2) = \beta_n(q^2) \cdot q^{2\ell}$ have a right-hand ($q^2 = 0$ to ∞) and a left-hand cut ($q^2 = -\infty$ to $-\mu^2$). The threshold behavior of $\alpha_n(q^2)$ and $\beta_n(q^2)$ is determined and used in an effective-range approximation based on the dominance of the pole terms.

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California U. [Dept. of Physics] Berkeley.

LOW-ENERGY LIMIT AND REGGE POLES (Abstract), by K. Igi. [1962] [1]p. [AF 49(638)327] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 303, Aug. 27, 1962.

A sum rule was derived under the assumption that no singularities in J with the vacuum-quantum numbers extend above $J = 0$ at $t = 0$, except for the Pomeranchuk-Regge pole. The analysis shows that there must exist another singularity in $1 > ReJ > 0$. We consider the

possibility, within this framework of the Regge-pole hypothesis, that the ABC trajectory might pass above J = 0. This would imply a "ghost" J = 0 state similar to the Pomeranchuk-Regge ghost, and also the possibility that the ABC trajectory might pass through R=+ = 2, giving rise to a spin-2 resonance with the vacuum-quantum numbers, similar to the Pomeranchuk spin-2 resonance. A sum rule was also proposed which enables one to check experimentally whether there exist any singularities between 0 and 1 besides the Pomeranchuk and ABC poles. Preliminary results are presented. A close connection between the slope of the Regge trajectory and the πN s-wave threshold behavior and p-wave scattering length is also discussed.

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California U. Dept. of Physics, Berkeley.

ATOMIC BEAM RESEARCH, by W. A. Nierenberg and H. A. Shugart. Final rept. Mar. 31, 1958-Mar. 31, 1962. June 30, 1962 [7]p. incl. table, refs. (AFOSR-2952) (AF 49(638)339) AD 285777 Unclassified

The atomic beam research program is devoted to the systematic measurement of various static nuclear and atomic properties. These properties include the nuclear spins, magnetic moments and quadrupole moments as well as atomic hyperfine structures, electronic angular moments and g-factors. These measurements provide a foundation upon which level systematics can be constructed, and also provide test information for nuclear structure theory. The technique employed is the atomic beam magnetic resonance method. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

NUCLEAR SPIN, HYPERFINE STRUCTURE, AND NUCLEAR MOMENTS OF 64-HOUR YTTRIUM-90, by F. R. Petersen and H. A. Shugart. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-3267) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)339 and Atomic Energy Commission) Unclassified

Also published in Phys. Rev., v. 125. 284-291, Jan. 1, 1962.

For abstract see item no. 244, Vol. V.

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California U. Dept. of Physics, Berkeley.

MAGNETOHYDRODYNAMICS, by K. M. Watson and L. G. Henyey. Final letter rept. Mar. 20, 1962, 4p. (AFOSR-2413) (AF 49(638)508) Unclassified

The work of this project has been concerned with theoretical research in magnetohydrodynamics, and has been concentrated in the fields of physics and astronomy. Publications resulting from the work are listed, by author, and briefly described. Studies have included flow stability and transport of ionized fluids in magnetic fields, and boundary condition effects on the stability of finite regions, experiencing gravitational acceleration. The work has also been extended to approximate transport equations in magnetic fields where binary ionized-particle collisions are not reversible, and to scattering phenomena, second order corrections to adiabatic processes, and to Fermi acceleration.

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California U. [Dept. of Physics] Berkeley.

MAGNETIC SUSCEPTIBILITY OF AN IMPERFECT GAS (Abstract), by T. Soda and A. N. Kaufman. [1962] [1]p. [AF 49(638)508] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 38, Jan. 24, 1962.

The equilibrium magnetic properties of a system of electromagnetically interacting molecules in a weak magnetostatic field $H_0(r)$ are investigated, using a linked cluster expansion technique. When the applied field varies slowly over molecular dimensions, a relation is obtained between magnetization $M(r)$ and the macroscopic field $H(r)$: $M(r) = (4\pi)^{-1} \times (\mu-1)H(r)$. The magnetic "Clausius-Mossotti function" $(\mu-1)/(\mu+1)$ is expressed as a power series in the activity, the coefficients of which are the traces of molecular cluster operators.

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California U. Dept. of Physics, Berkeley.

CYCLOTRON RESONANCE IN SOLIDS, by A. F. Kip. Final rept. May 1959-May 1962. May 27, 1962 [3]p. (AFOSR-2765) (AF 49(638)500) AD 612127 Unclassified

The method of cyclotron resonance has been demonstrated to be feasible as a means of investigating the Fermi surfaces in metals. Cyclotron resonances have been studied in tin, copper, aluminum, sodium, potassium, and silver. Results give cyclotron masses for various electron orbits in an applied magnetic field, and also contribute to the understanding of Fermi surfaces in these metals. In addition, numerous problems and phenomena connected with the cyclotron resonance technique have been studied. In particular, the effect of the direction of r.f. polarization relative to the externally applied magnetic field has been found to give detailed information about electron orbits. Experiments on tin show the usual Azbel-Kaner subharmonics when the applied field is perpendicular to the metal surface. The circumstances under which this anomalous result occurs have been investigated in some detail. Also under investigation are the signals which appear at low fields (up to 50 gauss), notably in tin. These have been shown not to be cyclotron resonance by their failure to scale with frequency, and their cause is now under investigation. High field oscillations attributable to the

de Haas-Shubnikov effect in both tin and aluminum are also being studied. The effects of field tipping and r.f. polarization on these signals are being considered. Some work has been done on a modification of the usual de Haas-van Alphen experiment, using a conventional lock-in detection scheme with low frequency field modulation.

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California U. Dept. of Physics, Berkeley.

AZBEL'-KANER RESONANCE IN TIN WITH MAGNETIC FIELD PERPENDICULAR TO THE SURFACE, by J. F. Koch and A. F. Kip. [1962] [4]p. incl. diagrs. (AFOSR-3409, (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)600 and Office of Naval Research) Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 473-476, June 15, 1962.

Resonances were observed only when the magnetic field was directed along or within 10° of the [100] axis and with the r.f. current directed along the [100] axis in the surface. The effective mass was $m^* = 0.57\ m_e$. Resonances were also observed with the r.f. current along the [001] axis with $m^* = 0.2$ and $0.3\ m_e$. Details are given of the experimental arrangement and of the material used. An explanation is given as to how these resonances arise and also why they have not been observed in other metals.

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California U. [Dept. of Physics] Berkeley.

CYCLOTRON-RESONANCE STUDIES IN Sn (Abstract), by F. Koch and A. F. Kip. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)600] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 477, Aug. 27, 1962.

Azbel'-Kaner resonance for single crystals of white Sn has been studied at 35 kmc for (100), (101), and (110) surfaces, using linear polarization of rf current both perpendicular and parallel to H. The m^* values and their dependence on the direction of H in these surfaces have been measured. It is found that considerable differences in the relative amplitudes of cyclotron-resonance series observed with H along the same axis but contained in different surfaces. This result is interpreted in terms of the geometry of the Fermi surface and Fermi velocity at the point of the orbit in the skin depth. The maximum signal amplitude is observed when j_{rf} is parallel to the velocity of the electron when it is in the skin. The amplitude varies as the $\cos^2$ of the angle of j_{rf} measured from the maximum. In addition to the usual surface resonances, the Azbel-Kaner resonance was observed in the vicinity of the [100], when this axis was perpendicular or at large angles with respect to the surface.

314

California U. [Dept. of Physics] Berkeley.

DYNAMIC EFFECTS OF THE SUHL-NAKAMURA INTERACTION IN MAGNETIC MATERIALS, by P. Pincus, P. G. DeGennes and others. [1962] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)600] and National Science Foundation) Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Published in Jour. Appl. Phys., v. 34: 1036-1037, Apr. 1963.

In a magnetic material, the nuclear spins are coupled via the exchange of virtual spin waves (Suhl-Nakamura interaction). This long range interaction is known to contribute to the nuclear transverse relaxation time. It also gives rise to a depression of the nuclear resonance frequency and in fact to a complete nuclear spin-wave spectrum. This spectrum is well defined even when the nuclear spins are far from saturation. In materials of sufficiently high concentrations of nuclear spins and at sufficiently low temperatures (helium range) nonlinear effects may occur in the nuclear resonance signal, as have been observed by Heeger, Portis, and Witt in $KMnF_3$. (Contractor's abstract)

315

California U. [Dept. of Physics] Berkeley.

QUANTUM OSCILLATIONS IN THE MICROWAVE SURFACE IMPEDANCE OF ALUMINUM AND TIN (Abstract), by C. C. Grimes, F. W. Spong, and A. F. Kip. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)600] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 477, Aug. 27, 1962.

Oscillations in the magnetic-field derivative of the microwave surface resistance of single crystals of aluminum and white tin at 1.5°K are reported. Because the oscillations are periodic in reciprocal magnetic field, with periods independent of microwave frequency, they are associated with the quantization of the orbital motion of electrons into Landau levels in a magnetic field, and are fundamentally related to the static effects of de Haas-van Alphen (dH-vA) and Shubnikov-de Haas. The observed periods and anisotropy were in quantitative agreement with some of the dH-vA periods seen by Gunnersen in aluminum and by Gold in tin. However, there appear to be some differences between the 2 effects. In the skin-resistance oscillations, for the

field along the diad axis of aluminum or the tetrad axis of tin, a single period was observed, rather than the beats observed in the dH-vA effect. The oscillations were studied with both longitudinal and transverse linear polarization of the microwave currents, and with the field both parallel and inclined to the surface.

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California U Dept. of Physics, Berkeley.

A STUDY OF IONOSPHERIC ABSORPTION PRODUCED BY SOLAR COSMIC RAYS, by R. A. Weir, Jr. [1962] [104]p. incl. diagrs. tables, refs. (AFOSR-4548) (AF 49(638)873) AD 296176 Unclassified

Absorption of cosmic radio noise in the lower ionosphere due to arrival of solar cosmic rays has been calculated for several locations at high magnetic latitudes. Calculation was made in 3 parts: (1) volume production rate of electrons from ionization, (2) equilibrium electron density resulting from competition between production and recombination processes, and (3) absorption of electromagnetic radiation passing through the ionized region. Calculation was made for proton energy spectra in the form of power law as observed by balloon-borne detectors following large solar flares. Calculated absorption was compared with observations obtained by riometers (relative ionospheric opacity meter) at Point Barrow, Fort Yukon, College, and Farewell, Alaska. For the solar proton event of July 14, 1959, the calculated absorption based on balloon data does not agree in magnitude nor latitude variation with the observations obtained by the Alaskan riometers. The lack of agreement in absolute magnitude indicates that the atmospheric coefficients used in obtaining the equilibrium electron density are in error. In particular, the collisional detachment as well as electron attachment coefficients appear to require considerable revision. The lack of agreement in the latitude variation substantiates observations at rocket altitude that the power law energy spectrum flattens considerably at proton energies below 100 mev. (Contractor's abstract)

317

California U. Dept. of Physics, Berkeley.

AN AURORAL-ZONE ELECTRON PRECIPITATION EVENT AND ITS RELATIONSHIP TO A MAGNETIC BAY, by R. R. Brown and W. H. Campbell. [1962] [10]p. incl. diagrs. table. (AFOSR-J875) (AF 49(638)-873) Unclassified

Also published in Jour. Geophys. Research, v. 67: 1357-1366, Apr. 1962.

The relationship of an auroral-zone electron precipitation event to a magnetic bay has been examined using simultaneous observations of x-ray intensity at balloon altitudes, ionospheric absorption of cosmic radio noise, geomagnetic micropulsations in the 5- to 30-sec period range, and variations in the geomagnetic elements H, D, and Z. These observations show that an intense electron bombardment of the upper atmosphere was in progress prior to the bay and suggest that the current system of the bay was "triggered" by the sudden intensification and expansion of the electron precipitation. The motion of the current system of the westward electrojet and the electrons precipitating on the atmosphere was toward the north, indicating that processes well out of the lines of force through the auroral zone, rather than local field conditions, were responsible for the movement. (Contractor's abstract)

318

California U. Dept. of Physics, Berkeley.

A COMPARISON OF AURORAL-ZONE X-RAY OBSERVATIONS FROM PERIODS WITH DIFFERENT LEVELS OF SOLAR ACTIVITY, by R. R. Brown. [1962] [4]p. incl. tables. (AF 49(638)873) Unclassified

Published in Jour. Geophys. Research, v. 67: 2681-2684, July 1962.

A comparison has been made of auroral-zone x-ray observations from balloon flights in the summer months of 1960 and 1961 to examine how electron precipitation varies with solar activity. The results of this study indicate that the frequency of x-ray events diminishes with a decline in solar activity. However, the daily electron flux over the auroral zone in June 1961 was twice as large as that in 1960. This result is attributed to position-motion effects of the electron precipitation.

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California U. Dept. of Physics, Berkeley.

ELECTRON PRECIPITATION ACCOMPANYING IONOSPHERIC CURRENT SYSTEMS IN THE AURORAL ZONE, by J. R. Barcus and R. R. Brown. [1962] [8]p. incl. diagrs. table. (AF 49(638)873) Unclassified

Published in Jour. Geophys. Research, v. 67: 2673-2680, July 1962.

From examination of x-ray and ionospheric absorption data during magnetic bays in the auroral zone, it has been found that electron precipitation on the atmosphere accompanies auroral-zone electrojets. The position of an electrojet and its associated electron precipitation region, rather than the amount of current in the system, largely controls the magnitude of x-ray and ionospheric absorption effects.

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California U. Dept. of Physics, Berkeley.

A PULSATING AURORAL-ZONE X-RAY EVENT IN THE 100-SECOND PERIOD RANGE, by D. S. Evans. [1962] [6]p. incl. diagrs. (AF 49(638)873) Unclassified

Published in Jour. Geophys. Research, v. 68: 395-400, Jan. 15, 1963.

The observation of a 100-sec periodicity in x-ray intensity at balloon altitudes during an intense auroral-zone x-ray event is described. The peaks in x-ray intensity are attributed to variations in the flux of electrons incident on the atmosphere rather than to motion effect of the electron precipitation. As such, the variations of the electron flux reflect the dynamics of the mechanism responsible for the precipitation of the electrons into the atmosphere. The relation of this type of periodic electron bombardment to pulsating aurora is considered.

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California U. Dept. of Physics, Berkeley.

[RESEARCH IN ATOMIC PHYSICS SCATTERING PROCESSES] by K. M. Watson. Final rept. Oct. 1, 1961-Sept. 30, 1962. Oct. 31, 1962, 3p. incl. refs. (AFOSR-4050) (AF AFOSR-62-121) Unclassified

Work discussed in this paper lies within 3 general categories: (1) many body problem and statistical mechanics; (2) atomic physics, and (3) elementary particle physics. This is a computation program to study errors inherent in the Hartree-Fock method which is used in describing scattering phenomena. Other similar computational programs will involve studies in certain atomic scattering problems, such as modification to the Kohn variational principle method.

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California U. Dept. of Physics, Berkeley.

CONCERNING THE NOTION OF TIME INTERVAL IN S-MATRIX THEORY, by M. L. Goldberger and K. M. Watson. [1962] [3]p. incl. diagr. (AFOSR-J18) (In cooperation with Princeton U., N. J.) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-121 and Atomic Energy Commission) AD 400384 Unclassified

Also published in Phys. Rev., v. 127: 2284-2286, Sept. 15, 1962.

The notion of time duration is considered within the framework of S-matrix theory. It is shown that Wigner's definition of the time delay, $-i\hbar[(d \ln S\, de)]$, for a scattering process permits one to define time duration in a coarse-grained sense. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

PION RESONANCES, by F. Zachariasen and C. Zemach. [1962] [10]p. incl. diagrs. refs. (AFOSR-J137) [AF AFOSR-62-121] AD 400188 Unclassified

Also published in Phys. Rev., v. 128: 849-858, Oct. 15, 1962.

A self-consistent calculation of some features of the low-energy pion resonances is performed by a "boot-strap" method which preserves unitarity and the analytic properties of scattering amplitudes and satisfies crossing symmetry approximately. The interaction of 2-pion states with pion-ω meson states is decisive for the properties of the ρ meson. Values of the ρ meson mass and width and the ω-meson width are obtained in terms of the pion and ω meson masses and are in fair agreement with experiment. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

MICROSCOPIC BASIS OF MACROSCOPIC MAGNETOSTATIC ENERGY, by A. N. Kaufman and T. Soda. [1962] [3]p. (AFOSR-J388) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-121 and Atomic Energy Commission) AD 408290 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1988-1990, Nov. 1, 1962.

A microscopic description of the electromagnetic interactions among a set of charged particles, valid to terms of order c^{-2}, is used to derive a number of well-known expressions for macroscopic electrostatic and magnetostatic energy and work. Particular attention is paid to the assumptions required for the validity of these expressions, and to the relations between the various non-equivalent expressions bearing the same name (such as magnetic work). (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

GROUND STATE OF THE HELIUM ATOM, by C. Schwartz. [1962] [3]p. incl. table. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-121, Atomic Energy Commission, and Office of Naval Research) Unclassified

Published in Phys. Rev., v. 128: 1146-1148, Nov. 1, 1962.

Following a recent attempt to analyze the rate of convergence of Rayleigh-Ritz variational calculations on the ground state of helium, a re-investigation is made of the usefulness of inserting fractional powers of the variables into the conventional Hylleraas series. The results are reported to be successfull. With a 164-term trial function containing half-powers of the variable $s = r_1 + r_2$, the best eigenvalue obtained by Pekeris, who used 1078 terms of the conventional type, has been matched. The extrapolated value for the nonrelativistic eigenvalue is -2.9037243771 au, with an estimated uncertainty of about 1.10^{-10} (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

UNSTABLE MODES IN THE SOLAR HYDROGEN CONVECTION ZONE, by K.-H. Böhm. [1962] [20]p. incl. diagrs. tables, refs. (AFOSR-J617) (AF AFOSR-62-199) AD 414074 Unclassified

Also published in Astrophys. Jour., v. 137: 881-900, Apr. 1, 1963.

For the model of the solar hydrogen convection zone suggested by Böhm-Vitense (1958), the fundamental modes with horizontal scales in the range 500 km ≤ (λ 2) ≤ 50000 km and their growth rates (degree of instability) have been calculated, using the linearized hydrodynamic equations and including the effects of radiative transfer. The variation of the mean temperature T_0 and density ρ_0 with depth, the dependence of the other thermodynamic functions on T_0 and ρ_0 for a partially ionized mixture of hydrogen and helium, and the detailed depth dependence of the opacity and its derivates have been taken into account. A detailed model of the stable photosphere and a schematic model of the lower parts of the chromosphere have been incorporated in the Böhm-Vitense model, in order to study the penetration of the convective motion into the stable part of the atmosphere. These computations may be considered as a first preparation for a later application of the non-linear convection theory of Ledoux, Schwarzschild, and Spiegel (1961) to the solar hydrogen convection zone. The conclusions from the results of the present calculations are as follows: (1) The growth rates increase approximately linearly with increasing wave number of the perturbation, i.e., much faster than in the case of a polytropic atmosphere. (2) At a scale (λ 2) = 500 km, wer are not yet close to the maximal rate of instability. Consequtnely, the "cutoff" of the unstable modes due to the radiative smoothing of temperature fluctuations must occur only at a considerable smaller (λ 2). This is due to the fact that the modes are mainly driven in layers a few hundred kilometers below the photosphere, where the opacity is some orders of magnitude higher than in the photosphere. (3) Modes of a small horizontal scale are essentially restricted to a (vertically) thin layer at the top of the convection zone; and (4) The overshooting of the convective motion into the stable parts of the atmosphere is larger for modes with larger values of λ. In the stable parts of the atmosphere the convective motion is mainly horizontal. Modes with a horizontal λ larger than about 6000 km probably penetrate a few thousand kilometers into the chromosphere. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

NUCLEAR SPINS, HYPERFINE STRUCTURES, AND NUCLEAR MOMENTS OF SCANDIUM-46 AND YTTRIUM-91, by F. R. Petersen and H. A. Shugart. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-66-1272) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-346] and Atomic Energy Commission) AD 640224 Unclassified

Also published in Phys. Rev., v. 128: 1740-1746, Nov. 15, 1962.

The atomic-beam magnetic-resonance method was used to study some atomic and nuclear properties of 84-day Sc^{46} and 58-day Y^{91}. The results are: SC^{46}, I = 4; uncorrected magnetic moment = +3.03 (2)nm; uncorrected quadrupole moment = +0.119 (6)b; $^2D_{3/2}$ state gJ = 0.7990 (8); a = +150.576 (9) mc/sec, b = +14.38 (14) mc/sec; $^2D_{5/2}$ state gJ = 1.1995 (18); a = +60.9069 (4) mc/sec; b = +20.41 (10) mc/sec. Y^{91}, I = 1/2, uncorrected magnetic moment = ±0.1634 (8)nm; $^2D_{3/2}$ state a = ±68.34 (2) mc/sec; hyperfine structure = ±136.69 (3) mc/sec; $^2D_{5/2}$ state a = ±34.35 (3) mc/sec; hyperfine structure = ±103.05 (4) mc/sec.

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California U. Dept. of Physics, Berkeley.

SINGULARITIES IN ANGULAR MOMENTUM OF THE SCATTERING AMPLITUDE FOR A CLASS OF SOLUBLE POTENTIALS, by A. O. Barut and F. Calogero. [1962] [11]p. incl. diagrs. refs. (AFOSR-J395) [AF AFOSR-62-373] AD 411908 Unclassified

Also published in Phys. Rev., v. 128: 1383-1393, Nov. 1, 1962.

The analyticity of the scattering amplitude in the variables, energy, and angular momentum is explicitly studied for square well and a class of continuous potentials having a $1/r^2$ type of core or tail. The trajectories of the poles in the ℓ plane and their residues have been determined numerically. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

ANALYTICITY IN ANGULAR MOMENTUM OF THE RELATIVISTIC MANY-CHANNEL S MATRIX FROM DISPERSION RELATIONS AND UNITARITY, by A. O. Barut. [1962] [5]p. incl. refs. (AFOSR-J536) [AF AFOSR-62-373] AD 411909 Unclassified

Also published in Phys. Rev., v. 128: 1959-1963, Nov. 15, 1962.

The analyticity of the scattering amplitude in angular momentum for N-coupled relativistic 2-body channels is investigated on the basis of Mandelstam representation and unitarity. The problem of the proof of the analytic properties of the amplitude is reduced to the boundedness of a particular kernel involving the left-hand discontinuity of the amplitude. The behavior of the Regge trajectories at inelastic thresholds is determined. The results are extended to relativistic models with infinite-dimensional unitarity relation but without crossing symmetry such as the Bethe-Salpeter amplitude. The implications of the results to the exact S-matrix theory are also discussed. (Contractor's abstract)

330

California U. Dept. of Physics, Berkeley.

TWO VACUUM POLES AND PION-NUCLEON SCATTERING by K. Igi. [1962] [8]p. incl. tables, refs. (AFOSR-64-0497) (AF AFOSR-62-373) AD 436378 Unclassified

Also published in Phys. Rev., v. 130: 820-827, Apr. 15, 1963.

A general expression is given for the pion-nucleon non-charge-exchange scattering amplitude for arbitrary energy and small momentum transfer on the assumption that only the vacuum pole P and the second vacuum pole P′ exist in the upper half J plane. Sum rules for non spin-flip and spin-flip amplitudes are derived and used, combined with the analysis of the high-energy π-N cross sections in terms of Regge poles, to investigate the behavior of P and P′ trajectories near t ≈ 0. For this purpose the importance of a precise measurement of the low-energy partial-wave phase shifts is emphasized. A sum rule for the S-wave pion-nucleon non-charge-exchange scattering length can be satisfied with $\alpha_{P'} \approx 0.5$.

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California U. Dept. of Physics, Berkeley.

ELEMENTARY PARTICLE THEORY OF COMPOSITE PARTICLES, by S. Weinberg. [1962] [6]p. (AFOSR-64-0499) (AF AFOSR-62-373) AD 436366 Unclassified

Also published in Phys. Rev., v. 130: 776-783, Apr. 15, 1963.

Any nonrelativistic theory may be rewritten by introducing fictitious elementary particles with arbitrary properties. No physical predictions are affected, provided that the interaction part of the Hamiltonian is correspondingly modified. The fictitious elementary particle provides a good representation of a real composite particle if the modified interaction is sufficiently weakened for perturbation theory to work. It corresponds to a truly elementary particle with infinite bare mass, and hence with Z = 0. It is shown how the latter condition yields a sum rule for the coupling of a composite particle to its constituents as a function of energy. The sum rule can be used to evaluate such coupling constants as that for the proton-electron-hydrogen vertex. The mathematical method used is that developed by Schmidt for the study of the Fredholm equation, and corresponds to the extraction of a single factor from the full Fredholm determinant.

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California U. Dept. of Physics, Berkeley.

ANALYTICITY AND UNITARITY OF GENERAL TRANSITION AMPLITUDES, by A. J. Dragt and R. Karplus. [1962] [9]p. incl. refs. (AFOSR-64-0500) (AF AFOSR-62-373) AD 436168 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 168-176, Oct. 1, 1962.

The analyticity and unitarity hypotheses for a general transition amplitude are formulated carefully for a world containing only 1 type of particle. From these hypotheses follows the conclusion that the general transition amplitude has no singularities on the positive real energy axis other than isolated singularities at physical thresholds. The analytic behavior near each such singularity is exhibited. At thresholds for processes involving an odd number of particles, the behavior is logarithmic.

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California U. Dept. of Physics, Berkeley.

A NOVEL APPROACH TO ELEMENTARY SCATTERING THEORY, by F. Calogero. [1962] [42]p. incl. diagrs. refs. (AFOSR-64-0501) (AF AFOSR-62-373) AD 436166 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 261-262, Jan. 1, 1963.

An approach to potential scattering is discussed. The problem of evaluating scattering phase-shifts and bound-state energies is discussed. The effect of the potential on the wave function is also analyzed. Approximating formulas are given. A powerful representation for the tangent of the phase shift, valid if the potential never changes sign and the phase shift is smaller in magnitude than π/2, is obtained. Bounds on the phase shifts and on their derivatives with respect to linear and angular momentum are established. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

SPONTANEOUS BREAKDOWN TO OCTET SYMMETRY, by S. L. Glashow. [1962] [3]p. (AFOSR-64-0502) (AF AFOSR-62-373) AD 436171 Unclassified

Also published in Phys. Rev., v. 130: 2132-2134, June 1, 1963.

A model of strong interactions with the octet symmetry of Gell-Mann and Ne'eman is considered, and a spontaneous breakdown of this symmetry leading to nondegenerate baryon masses is sought. The Gell-Mann mass formula is deduced for the physically relevant symmetry-breaking solutions.

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California U. Dept. of Physics, Berkeley.

UNSTABLE PARTICLES IN S-MATRIX THEORY, by D. Zwanziger. [1962] [11]p. incl. diagrs. refs. (AFOSR-64-0504) (AF AFOSR-62-373) AD 436374 Unclassified

Also published in Phys. Rev., v. 131: 888-898, July 15, 1963.

The consequences of the existence of complex poles in scattering amplitudes, corresponding to resonances or unstable particles, are investigated. Specific examples show that corresponding to such poles are normal threshold cuts lying near the physical region and which cause 'wooly cusps' in scattering cross sections. The discontinuity across such a cut is expressed by a unitarity-like relation in terms of unphysical amplitudes with unstable external particles defined by the residues of the complex poles. More generally, it is shown that the Landau equations for the singularities must be extended to include all unstable as well as stable particles. The Cutkosky formulas specify the corresponding discontinuities in terms of the physical and unphysical amplitudes. (Contractor's abstract)

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[California U. Dept. of Physics, Berkeley]

DECAYS OF VERY UNSTABLE PARTICLES, by S. L. Glashow. [1962] [2]p. (Sponsored jointly by Air Force [Office of Scientific Research] under [AF AFOSR-62-373] and North Atlantic Treaty Organization) Unclassified

Published in Phys. Ltrs., v. 2: 251-252, Oct. 1, 1962.

Particles so short-lived that the usual approximations and conclusions are invalid are considered. Different decay modes may have different line shapes and mean energies; this behavior may help to determine spins. In particular the spins of hyperon isobars, the new KK resonance and the ρ meson are discussed.

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California U. Dept. of Physics, Berkeley.

AURORAL ZONE X-RAY PULSATIONS IN THE 1- TO 15-SECOND PERIOD RANGE, by C. D. Anger, J. R. Barcus and others. [1962] [8]p. incl. diagrs. (AFOSR-J392) (AF AFOSR-62-422) AD 411898 Unclassified

Also published in Jour. Geophys. Research, v. 68: 1023-1039, Feb. 15, 1963.

Auroral zone x-ray pulsation in the 1- to 15-sec period range, observed at Macquarie Island, Australia, on Mar. 5, 1962, and College, Alaska, on June 29, 1962, are described. Both observations indicate that the time intervals between the x-ray bursts are not unique; the average intervals over the pulsation events were 7.8 and 8.8 sec, respectively. These observations indicate that the pulsation periods in this range are determined by acceleration or pitch-angle redistribution processes in the equatorial plane rather than any fundamental, periodic motion of the electrons along lines of force in the geomagnetic field.

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California U. Dept. of Physics, Berkeley.

SIMULTANEOUS ELECTRON PRECIPITATION IN THE NORTHERN AND SOUTHERN AURORAL ZONES, by K. A. Anderson, R. R. Brown and others. [1962] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-422, National Science Foundation, and Office of Naval Research) AD 297111 Unclassified

Also published in Jour. Geophys. Research, v. 67: 4075-4077, Sept. 1962.

A series of simultaneous high-altitude balloon flights were carried out from College, Alaska, and Macquarie Island, Australia, for the purpose of comparing features of electron precipitation into the northern and southern auroral zones at approximately the same geomagnetic longitude. Substantial fluxes of auroral zone x-rays were observed in both hemispheres during magnetic bay activity. The x-ray observations indicate that the electron influx in both hemispheres extended over a region 3° wide in latitude and 16° in longitude. The near equality of the x-ray fluxes in both auroral zones suggests that the electron precipitation originated from processes far out on the lines of force, near the equatorial plane. The magnetic and ionospheric disturbances accompanying the x-ray event are discussed.

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California U. Electronics Research Lab., Berkeley.

A PHASE-PLANE APPROACH TO RELAY SAMPLED-DATA FEEDBACK SYSTEMS, by F. J. Mullin and E. I. Jury. [1958] [11]p. incl. diagrs. (AFOSR-3573) (AF 18(600)1521) Unclassified

Presented at Pacific General meeting of the AIEE, Sacramento, Calif., Aug. 19-22, 1958.

Also published in Trans. Amer. Inst. Elec. Engineers, v. 77 (Part II): 517-524, Jan. 1959.

For abstract see item no. CAL.04:016, Vol. II.

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California U. Electronics Research Lab., Berkeley.

PHOTODISSOCIATION OF MOLECULES FOR EXCITATION OF AN OPTICAL MASER, by J. R. Singer. Jan. 8. 1962. 7p. incl. diagrs. table. (Series no. 60; issue no. 429) (AFOSR-2251) (AF 49(638)102) AD 403011 Unclassified

In working with optical masers, it is necessary to obtain a very narrow emission source in order to utilize its many possibilities. The best method of obtaining this source is to eliminate doppler broadening by observing atomic transition perpendicular to the path of an atomic beam; this method can be adapted to optical masers. The system studied involves photodissociation of molecules in which 1 dissociated atom appears in an

excited state. General process may be described by the following reactions: (1) $h\nu_0 + AB \rightarrow A^* + B' + K.E.$ and (2) $A^* \rightarrow h\nu_1 + A$, where $h\nu_0$ is a high energy photon interacting with a molecular compound AB composed of atoms A and B.

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California U. Electronics Research Lab., Berkeley.

AN ELECTRON STEAM INSTABILITY, by W. B. Bridges and C. K. Birdsall. Mar. 23, 1962 [202]p. incl. illus. diagrs. tables, refs. (Series no. 60; issue no. 443) (AFOSR-2658) (AF 49(638)102) AD 284291 Unclassified

The dynamic behavior beyond the limit for the stream flowing between and normal to infinite parallel-plane electrodes is treated. The model used to approximate the multivelocity stream consists of a large number of charges which are injected one at a time into the diode and are allowed to move under the influence of their own electric fields and that of the electrodes. The trajectories of the sheets, voltages, currents, and energies were calculated with the help of a digital computer. For streams of finite cross section, circular or rectangular, the static solutions are obtained for the stream flowing normal to infinite parallel plane electrodes. The dynamic behavior obtained is offered to explain some of the effects observed in low-noise microwave tubes and plasma diodes, and is proposed as a fast switching circuit. The peak in diode shot noise at the plasma frequency of the cathode potential minimum appears as the oscillation frequency of the diode treated here. The stream dynamic behavior, considered as a change of state at limiting, is proposed as a 2-state switching element for nanosecond or shorter rates, with possible computer applications. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

[MICROWAVE ELECTRONICS]. Final rept. Jan. 1, 1957-Sept. 30, 1962, 8p. incl. refs. (AFOSR-4516) (AF 49(638)102) Unclassified

Work has been done on (1) electron streams (focusing, noise properties, instabilities) and (2) quantum electronics (mainly optical masers and investigations of optical maser materials). The electron stream work has been concentrated in instabilities for streams formed and focused in different ways. The transient behavior at limiting current has been obtained for the first time. Results show that part of the classical solutions made decades ago are in serious error. Similar work with streams in drift tubes, in confined flow and in Harris flow (centrifugal electrostatic focusing) are presently being studied in order to understand in detail the onset of instabilities in various electron and ion stream configurations. The quantum electronics projects have covered a number of microwave and optical maser problems such as finding suitable maser materials and new ways of obtaining maser operation, especially in new frequency ranges. The study of 2-level masers has resulted in a general analysis of the interaction between magnetic and electric dipole emitters and the radiation wave. Another research effort of considerable import has been the initiation of studies of a photodissociation optical maser. A list of publications and technical papers presented at conferences is given.

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California U. Electronics Research Lab., Berkeley.

THREE-LEVEL MASER MATERIALS: A SURVEY OF POTENTIAL MATERIALS, I, by J. Wakabayashi. Mar. 7, 1962, 77p. incl. diagrs. tables, refs. (Series no. 60; issue no. 439) (AFOSR-4556) (AF 49(638)102) AD 296875 Unclassified

This report is a study of potential materials for use in the maser. The problem of finding or making crystals with the desired qualities can be divided into 2 parts. The first is to choose the paramagnetic ion suited to the purpose. The second is to choose a suitable diamagnetic, dielectric solid to serve as a host for the paramagnetic ion. A list of the most promising maser materials and their properties is presented.

344

California U. Electronics Research Lab., Berkeley.

WAVES IN DRIFTING AND ACCELERATING ELECTRON STREAMS IN RADIAL FLOW, by W. B. Bridges and C. K. Birdsall. June 29, 1962, 29p. incl. diagrs. refs. (Series no. 60, issue no. 459) (AFOSR-4557) (AF 49-(638)102) AD 296452 Unclassified

The solutions for space-charge waves obtained by Hahn (1939) and Ramo (1939) for a rectilinear, drifting stream are quite well known. Less well known are the more mathematically complicated solutions obtained when the stream flow is along radial lines and the stream is accelerating for the following cases: (1) first order current for radial drifting flow, (2) current and velocity in accelerating parallel flow, and (3) accelerating radial flow. The present work attempts to unify all of these cases and a few more into one general solution.

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California U. Electronics Research Lab., Berkeley.

PLASMA OSCILLATIONS AND PARTICLE TRAJECTORIES IN A DRIFTING ELECTRON STREAM: PALMER DIAGRAMS, by C. K. Birdsall. June 29, 1962, 44p. incl. diagrs. refs. (Series no. 60; issue no. 458) (AFOSR-4558) (AF 49(638)102) AD 296390 Unclassified

Electron trajectories are obtained for the Hahn-Ramo space-charge waves. The approach is to use Lagrangian form of hydrodynamic equations of motion and of continuity. This is in contrast with the more common Eulerian jellied-out fluid approach where the

particle identity is lost. The model used is developed in some detail. Trajectory plots are given for the faster and slower space-charge waves by themselves, and for velocity modulation for the ratios of driving frequency to selected plasma frequency ω/ω_p, of 0.5, 1.0, and 2.0. (Contractor's abstract)

346

California U. Electronics Research Lab., Berkeley.

TRAVELING WAVE FOCUSING FOR PLASMA CONTAINMENT, by C. K. Birdsall and A. J. Lichtenberg. [1959] [3]p. [AF 49(638)102] Unclassified

Published in Phys. Rev. Ltrs., v. 3: 163-164, Aug. 15, 1959.

The focusing and contraction of low density dc plasma columns carrying currents up to 100 mA were studied under confining field frequencies in the range 3 to 25 mc/sec. The amount of contraction was proportional to the applied power in this range. It is believed that the electrons are being focused by the traveling fields and the ions are contained in the potential well thus formed. With large structures and higher power it should be possible to focus both electrons and ions. At 1000 mc sec, the ionization effects of the high frequency effects were very strong and the plasma was maintained without a dc discharge. No focusing was observed, but this may have been masked by the intense excitation.

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California U. Electronics Research Lab., Berkeley.

PREBUNCHED BEAM TRAVELING-WAVE TUBE STUDIES, by A. J. Lichtenberg. [1961] [7]p. incl. diagrs. table. (AF 49(638)102) Unclassified

Published in I. R. E. Trans. on Electron Devices, v. ED-9: 345-351, July 1962.

A traveling wave tube with a prebunched beam is found to have a considerably higher efficiency than the same tube without prebunching. For the particular tube tested, the efficiency is increased from 20 to over 35% at a gain of 8. Computer calculations using a discrete disk model give similar results. The beam is bunched tightly in energy at the position of highest efficiency, indicating that very high efficiency could be obtained with a depressed collector. Both current and velocity modulation are required for prebunching, and are obtained by means of a current grid followed by an inductively tuned velocity modulation cavity. The requirements of the current grid are not great so that operation should be possible at frequencies well above the normal operating region of a microwave triode. The operation of the tube is sensitive to the output match, and it appears to be difficult to obtain a good match with the beam on. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

ARTIFICIAL HIGH TEMPERATURE SOURCES IN NOISE MODELING STUDIES, by J. R. Whinnery and M. A. Bellack. [1962] [6]p. incl. diagrs. table, refs. [AF 49(638)102] Unclassified

Published in Microwaves: Proc. Fourth Internat'l. Cong. on Microwave Tubes, Scheveningen (Netherlands) (Sept. 3-7, 1962). Eindhoven, Centrex Publishing Co., 1963, p. 478-483.

Studies show that noise experiments might be scaled to an order of magnitude lower in frequency and greater in size, with maintenance of similar voltage distributions and transit angles to equivalent positions, if electron sources with equivalent temperatures from 100 to 1000 times usual cathode temperatures were available. A simple idea for obtaining such sources is that of amplifying velocity distributions along an electron stream, say by traveling-wave amplification. The noise amplified might be that originally present in the beam, or additional random noise may be impressed at the amplifier input. In the latter case, distribution, as given by analysis of a simple model, is not half-Maxwellian, but appears to be a reasonable approximation to it in form. A preliminary experiment, carried out on a tube designed for depressed collector operation, showed an effect from the r.f. fields of the helix which was consistent with the known gain of the tube The result-noise temperature of the beam, estimated from retarding field current measurements, corresponded to about 10^6 K, and seemed to have reasonable approximation to a half-Maxwellian distribution.

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California U. [Electronics Research Lab.] Berkeley.

OPTICAL MASERS UTILIZING MOLECULAR BEAMS (Abstract), by J. R. Singer and I. Gorog. [1962] [1]p. [AF 49(638)102] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 14, Jan. 24, 1962.

Molecular beams optical masers having the advantage of providing a continuous optical emission from molecules which can be excited to an inverted Boltzmann distribution in an irreversible manner. A number of molecules have been chosen, including some alkali halides, as possibilities for obtaining coherent optical emission at various infrared and optical frequencies. Of these, experimental studies of rubidium iodide have been undertaken for a feasibility investigation of the general approach. The excitation of RbI is accomplished by irradiation with a broad 2537-A line of mercury. Rubidium iodide dissociates under the uv into an excited rubidium atom and an iodine atom. The rubidium atoms decay to the ground state with emission of photons of 7600 or 7947A. By providing a Fabry-Perot etalon, it

should be possible to obtain a coherent induced emission output at these wavelengths. The process is general, and a number of other molecular beam masers will also be discussed. Practically all the alkali halides are suitable, and the process presents the advantages of broad-line absorption and narrow-line emission.

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California U. Electronics Research Lab., Berkeley.

PARAMAGNETIC RESONANCE SPECTRUM OF Fe^{3+} IN CALCITE, by J. Wakabayashi. [1962] [3]p. incl. diagrs. (AF 49(638)102) Unclassified

Published in Jour. Chem. Phys., v. 38: 1910-1912, Apr. 15, 1963.

The paramagnetic spectrum of an impurity in natural crystals of calcite has been examined and identified as that of Fe^{3+}. The value of g is assumed to be two. Approximate values for $|D|$ and $|a - F|$ are 2.9 and 0.44 Gc, respectively. The value of the cubic field splitting parameter a was not determined.

351

California U. Electronics Research Lab., Berkeley.

APPLICATIONS OF GRAPH THEORY TO SOLUTION OF SOME SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS, by I. Cederbaum. Jan. 23, 1962, 10p. incl. diagrs. tables, refs. (Series no. 60; issue no. 432) (AFOSR-2104) (Sponsored jointly by Air Force Office of Scientific Research, Dept. of the Army, and Office of Naval Research under AF 49(638)1043) AD 278393 Unclassified

Graph-theoretic arguments using the orthogonality of the cut-set, the circuit subspaces and the relation between the nonvanishing terms in the expansion of a determinant and the cycles in the associated graph are applied to render all the binary solutions of systems of linear equations. Application is made to systems of linear algebraic equations and cycles and undirected cut-sets. Since the number of cycles and their duals in a given bounded finite graph may be very high the solutions may be presented in a closed form through the use of an adjacency matrix.

352

California U. Electronics Research Lab., Berkeley.

THE MINIMIZATION OF BOOLEAN FUNCTIONS CONTAINING UNEQUAL AND NONLINEAR COST FUNCTIONS, by M. A. Breuer. Jan. 22, 1962, 19p. incl. diagrs. (Series no. 60; issue no. 431) (AFOSR-2445) (Sponsored jointly by Air Force Office of Scientific Research, Dept. of the Army, and Office of Naval Research under AF 49-(638)1043) AD 278392 Unclassified

A method is presented for minimizing Boolean functions by employing linear programming. The classical model of a Boolean function in vector space is presented. From this model, the linear program for the minimization of Boolean functions in prime implicant form with arbitrary constant cost coefficients is formulated. Variable nonlinear cost functions, derived from the fan-out problem are then considered. Methods for taking into consideration lead length, loading, and fan-in restrictions are discussed. In essence, the technique simplifies the Boolean functions to a form which is minimal in cost to implement. (Contractor's abstract)

353

California U. Electronics Research Lab., Berkeley.

ANALYSIS OF ERRORS IN THE ESTIMATION OF THE IMPULSIVE RESPONSE, by H. Kwakernaak. Feb. 6, 1962, 33p. incl. diagrs. tables. (Series no. 60, issue no. 434) (AFOSR-2576) (Sponsored jointly by Air Force Office of Scientific Research, Dept. of Army, and Office of Naval Research under AF 49(638)1043) AD 278394 Unclassified

The method of finding the impulsive response of a linear, time-invariant system by the computation of correlation-functions of input and output, is investigated. The effects of (1) truncation of the impulsive response, (2) sampling the data, and (3) additive noise at the output, are studied, especially under asymptotic conditions, i.e., for long observation times. The truncation distorts the actual impulsive response primarily at the endpoints of the interval considered. For this reason, the interval should be chosen sufficiently large. The sampling has a smearing effect on the impulsive response by reducing the resolving power, but on the other hand can have a highly smoothing effect on the noise. The sampling rate also greatly influences the amount of computational work to be carried out. The errors of the estimate due to the noise are proportional to $\sqrt{\frac{1}{T}}$, which is a usual result for this type of estimate. Also it was noted that in many cases the statistical errors depend very much on the sampling interval, and may even become infinite if the sampling interval goes to zero. Some results of a computer-study to check the theoretical results are given. (Contractor's abstract, modified)

354

California U. Electronics Research Lab., Berkeley.

NOTES ON SYSTEM THEORY, VOL. I, Oct. 1, 1961, 71p. incl. diagrs. tables, refs. (Series no. 60; issue no. 408) (AFOSR-3400) (Sponsored jointly by Air Force under AF 19(604)5466, Air Force Office of Scientific Research under AF 18(600)1521 and AF 49(638)-1043; National Science Foundation and Office of Naval Research) AD 270449 Unclassified

For abstract see item no. 294, Vol. V.

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California U. Electronics Research Lab., Berkeley.

[BASIC RESEARCH IN ELECTRONICS] Final rept. Feb. 15, 1962 [67]p. incl. diagrs. refs. (Consolidated quarterly progress rept. no. 4) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), Office of Naval Research, and Signal Corps under AF 49(638)1043) Unclassified

Some of the topics discussed in this report are: circuits (time varying networks, harmonic oscillators), microwave electronics and plasmas (fast wave, electron stream interactions, plasma magnetrons), radiation and propagation (frequency-independent antennas, surface wave studies), solid-state electronics (photovoltaic effects, tunneling phenomena), system theory (optimal control, studies of Boolean functions), and bioelectronics (electrophysiological properties of cortex).

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California U. Electronics Research Lab., Berkeley.

NOTES ON SYSTEM THEORY, VOLUME II, Feb. 15, 1962, 123p. incl. diagrs. (Series no. 60; issue no. 436) (AFOSR-3184) (Sponsored jointly by Air Force, Air Force Office of Scientific Research under AF AFOSR-62-70 and AF AFOSR-62-340; National Science Foundation and Office of Naval Research) Unclassified

The purpose of these notes is twofold: first to provide an auxiliary publication medium for short contributions for research in systems and related areas; second, to contribute to the development of system theory as a basic scientific discipline. Some of the topics discussed are: analysis of p-nary time series, infinite and finite distinguishing sequences, binomial coefficients, stability determinants in linear discrete systems, boundedness of motions, Aizerman's conjecture for third-order system, autocorrelation and crosscorrelation functions of complete recurrent sequences, and a note on lumped time invariant systems.

357

California U. Electronics Research Lab., Berkeley.

PROOF OF A GENERAL RELATIONSHIP USED IN THE STABILITY TEST OF LINEAR DISCRETE SYSTEMS: AN ADDENUM TO A SIMPLIFIED CRITERION FOR LINEAR DISCRETE SYSTEMS AND ON THE ROOTS OF A REAL POLYNOMIAL INSIDE THE UNIT CIRCLE AND A STABILITY CRITERION FOR LINEAR DISCRETE SYSTEMS, by E. I. Jury. [1961] [8]p. (Series no. 60; issue nos. 373 and 425) (AFOSR-4796) (AF AFOSR-62-70) AD 285176; AD 408584 Unclassified

For abstract see item no. 1302, Vol. V.

358

California U. [Electronics Research Lab.] Berkeley.

STABILITY AND APERIODICITY CONSTRAINTS FOR SYSTEM DESIGN, by E. I. Jury and T. Pavlidis. [1962] [5]p. incl. refs. (AFOSR-J1288) (AF AFOSR-62-70) AD 424359 Unclassified

Also published in I. E. E. E. Trans. on Circuit Theory, v. CT-10: 137-141, Mar. 1963.

Analytic tests of stability are applied for systems design. The continuous system for the general case is discussed in detail and the corresponding critical constraints for stability for the discrete case are derived. The critical constraint for aperiodicity for both continuous and discrete cases are also obtained. The examples show the methods can be extended to higher order systems.

359

California U. [Electronics Research Lab.] Berkeley.

A LITERATURE SURVEY OF BIOCONTROL SYSTEMS, by E. I. Jury and T. Pavlidis. [1962] [8]p. incl. diagrs. refs. (AFOSR-J1602) (AF AFOSR-62-70; AF AFOSR-63-117) AD 427624 Unclassified

Also published in I. R. E. Trans. on Automatic Control. v. AC-8: 210-217, July 1963.

Review of the various aspects of biological control systems and their relation to feedback theory is presented. To systematize the study of biocontrol systems, the material is classified into the following topics: (1) general human operator dynamics; (2) neuromuscular systems; (3) eye dynamics; (4) respiratory and circulatory systems, (5) biological process control; and (6) central nervous systems and brain. Each of the above topics is summarily discussed and separately documented with the pertinent literature and research activities. In the conclusion, the connection between the recent theoretical work in feedback control and the problems of biocontrol systems is discussed. It is hoped that with this survey a new burst of research activities on the part of control scientists in the challenging field of biocontrol systems will be materialized. (Contractor's abstract)

360

California U. [Electronics Research Lab.] Berkeley.

THE OPERATIONAL SOLUTION OF DIFFERENCE-DIFFERENTIAL EQUATIONS USING THE MODIFIED z TRANSFORM, by M. A. Pai. [1962] [2]p. incl. diagr. (AF AFOSR-62-70) Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-7: 124-125, Oct. 1962.

In this communication the usefulness of modified z transform has been demonstrated in solving linear constant coefficient difference-differential equations.

It is particularly useful in calculating transient responses of continuous systems having time delays, this method avoids having to evaluate roots of transcendental equations. This method can be easily extended to systems having more than one but otherwise commensurable time delays.

361

California U. [Electronics Research Lab.] Berkeley.

MINIMUM PERIOD OF OSCILLATION OF TUNNEL-DIODE OSCILLATORS, by R. S. Fepper. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-3370) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340) Unclassified

Presented at Western Electronic Show and Convention, Los Angeles, Calif., Aug. 21-24, 1962.

Also published in I. E. E. E. Trans. on Circuit Theory, v. CT-10: 60-66, Mar. 1963. (Title varies)

Consideration is given the general problem of determining the conditions to achieve the minimum period of oscillation, regardless of wave-shape, for simple electronic oscillators. In particular, emphasis is placed on the general minimum period problem for the tunnel-diode oscillator having a series inductive-resistive load. The minimum period of oscillation is established by varying the load's parameters. Various nonlinear analysis techniques show that the minimum period of oscillation is never obtained for a harmonic mode of oscillation. It is shown that the minimum period of oscillation is obtained by using a load resistance approximately equal to zero and no externally added inductance. The results are confirmed by experiment. The conditions are also given for determining whether the tunnel diode will operate as a soft oscillator, hard oscillator, or be truly bistable.

362

California U Electronics Research Lab., Berkeley.

STABILITY OF A CLASS OF DISCRETE CONTROL SYSTEMS CONTAINING A NONLINEAR GAIN ELEMENT. by S. Kodama. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-J1008) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham) and Office of Naval Research under AF AFOSR-62-340) Unclassified

Presented at Joint Automatic Control Conf., New York, June 1962.

Also published in I. R. E. Trans. on Automatic Control, v. AC-7: 102-109, Oct. 1962.

For abstract see item no. 290, Vol. V.

363

California U. [Electronics Research Lab.] Berkeley.

COMMUNICATION SYSTEMS OF CHANNELS WITH BOUNDED NONDECREASING COSTS PER UNIT OF INFORMATION FLOW, by I. T. Frisch. [1962] [5]p. incl. diagrs. refs. (AFOSR-J1397) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham) and Office of Naval Research under AF AFOSR-62-340) AD 426357 Unclassified

Also published in I. E. E. E. Trans. on Commun. Systems. v. CS-11: 36-40, Mar. 1963.

Given a communication system of stations and capacitated channels in which there is associated with each channel a bounded nondecreasing cost per unit of information flow, flow patterns are found that maximize the information rate between a given pair of terminal stations at minimum over-all cost. (Contractor's abstract)

364

California U. [Electronics Research Lab.] Berkeley.

FUEL OPTIMAL CONTROL FOR PULSE-AMPLITUDE-MODULATED TIME-INVARIANT SAMPLED-DATA SYSTEM, by C. T. Lee and C. A. Desoer. [1962] [19]p. incl. diagrs. (AFOSR-64-0314) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340) Unclassified

Also published in Jour. Electronics and Control, v. 15: 363-381, Oct. 1963.

Given a linear time-invariant sampled-data system described by $X_{K+1} = AX_K + BU_{K+1}$, where X_K is the state-vector at the Nth sampling instant, U_{R+1} the control vector, and A, B are n x n and n x r constant matrices, and a number N of sampling periods, the problem is to find a sequence of control vectors that brings the state to the origin in N sampling periods or less with the least consumption of fuel. The fuel consumption is defined by $I = \sum_{i=1}^{N} \sum_{\alpha=1}^{r} |u_i^{(\alpha)}|$. For unbounded controls, this problem is solved, and the optimal feedback is described. For bounded controls, we establish general properties of the optimal control but find the feedback only for a single input second-order system. (Contractor's abstract)

365

California U. [Electronics Research Lab.] Berkeley.

OPTIMUM ROUTES IN COMMUNICATION SYSTEMS WITH CHANNEL CAPACITIES AND CHANNEL RELIABILITIES, by I. T. Frisch. [1962] [5]p. incl. diagrs. (AFOSR-64-0322) (Sponsored jointly by Air Force

Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340) Unclassified

Also published in I. E. E. E. Trans. on Commun. Systems, v. CS-11: 241-245, June 1963.

Given a communication system in which each channel has associated with it a channel capacity: (1) If there is associated with each channel a probability of correct transmission for each character sent, find the route between a given pair of stations which maximizes the information rate with the probability of correct character transmission over that route not less than some prescribed minimum; (2) If there is also associated with each channel a probability of the channel being operative, find a route between a given pair of stations of maximum information capacity with the probability of the route being operative not less than some minimum level; (3) If there is also associated with each channel the probability of the channel being occupied, find a route between a given pair of stations such that the information capacity is maximized with the probability of each channel being unoccupied not less than some minimum level. Algorithms are developed for finding routes between a given pair of stations, with maximum capacity and with reliability not less than some prescribed minimum value. (Contractor's abstract, modified)

366

California U. [Electronics Research Lab.] Berkeley.

LINEAR TIME VARYING G-C NETWORKS: STABLE AND UNSTABLE, by C. A. Desoer and A. Paige. [1962] [11]p. incl. diagrs. tables. (AFOSR-64-0326) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340; and National Science Foundation) AD 435906 Unclassified

Also published in I. E. E. E. Trans. on Circuit Theory, v. CT-10: 180-190, June 1963.

The stability of linear time varying conductance-capacitance networks was studied. Several sets of sufficient conditions for their stability are given. In particular, instability can occur only if both the G matrix and the C matrix are time varying. In the limit of very large pump frequencies, the stability of periodic piecewise constant networks is determined by a simple relation. The design of unstable G-C networks is explained and illustrated by two examples. In the second example, the q vector (whose components are sums of charges on condensers in certain cut sets) has components that behave like sine waves modulated by increasing exponentials. (Contractor's abstract)

367

California U. [Electronics Research Lab.] Berkeley.

CHANGING THE STATE OF A LINEAR SYSTEM BY USE OF NORMAL FUNCTION AND ITS DERIVATIVES, by S. C. Gupta and L. Hasdorff. [1962] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under [AF AFOSR-62-340]) Unclassified

Published in Jour. Electronics and Control, v. 14: 351-359, Mar. 1963.

For a linear system with real poles, 2 problems have been studied: (1) achieving a desired state from ground state in minimum time, and (2) achieving maximum distance from the origin (ground state) when the excitation is magnitude limited. Since the state of a system can be changed in zero time using the impulse-function and its derivatives, the impulse function is approximated by normal function and the above problems are attacked using this normal function and its derivatives. This method shows to what degree the impulse function response can be approximated using this type of excitation and shows the practicality of this type of input. (Contractor's abstract, modified)

368

California U. [Electronics Research Lab.] Berkeley.

THE DETERMINATION OF LYAPUNOV FUNCTIONS WHICH VERIFY AIZERMAN'S CONJECTURE (Abstract), by I. J. Williams. [1962] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340; and Air Research and Development Command) Unclassified

A direct procedure for the determination of Lyapunov functions which verify Aizerman's conjecture concerning the stability of nonlinear systems is presented. This procedure will determine a Lyapunov function of the Lur'e type which will accomplish this result for a particular system if a function of this type exists. The problem of determining the Lyapunov function is reduced to that of determining the function for a family of linear systems. It is shown that the derivative of this function must satisfy certain constraints in order to be a suitable Lyapunov function for this family of linear systems. These constraints require the derivative of the Lyapunov function to be zero along specified vectors determined from the dynamics of the linearized system. The derivative of the Lyapunov function is constructed incorporating these constraints which considerably reduces the number of parameters to be determined. The elements of the Lyapunov function itself are found by solving a set of linear algebraic equations. This procedure is a direct process by which the Lyapunov function can be found if it exists without resorting to trial and error methods and consequently is well suited for application to third and higher order systems. Several third and fourth order examples are presented to demonstrate this procedure. (Contractor's abstract)

369

California U. [Electronics Research Lab.] Berkeley.

LIMITATIONS ON THE TRANSIENT RESPONSE OF POSITIVE REAL FUNCTIONS, by R. A. Rohrer.

[1962] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340) Unclassified

Published in I. E. E. E. Trans. on Circuit Theory, v. CT-10: 110-111, Mar. 1963.

Restrictions on the impulse and step responses associated with positive real network functions have been previously discussed. It is possible to obtain a further set of simple limitations which apply to the even-order transient responses of networks characterized by p. r. functions. The transient responses of a system can be simply designated by $h_k(t) = \frac{1}{2\pi j}\oint_C S^k H(s)ds$, where $h_0(t)$ is the impulse response, $h_{-1}(t)$ the step response. The cosine inequalities introduced by Zeemanian to bound the frequency attenuation for filters with monotonic step response, may be applied here to obtain restrictions on the even-order transient response associated with p. r. system functions.

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California U. [Electronics Research Lab.] Berkeley.

MACHINE INDEPENDENCE IN COMPILING, by H. D. Huskey. [1962] [10]p. (Sponsored jointly by Air Force Office of Scientific Research, [Army Research Office (Durham)] and Office of Naval Research under [AF AFOSR-62-340]; and Bell Telephone Labs.) Unclassified

Published in Symbolic Languages in Data Processing, Proc. of Symposium, Rome (Italy), Mar. 26-31, 1962. New York, Gordon and Breach, 1962, p. 219-228.

Two schemes have been described. The first is a 3- or 4-stage (conceptually) processor in which only the last stage is essentially computer dependent. In converting to a new computer, parts of the last stage (assembly program) must be hand modified. In the second scheme a subset of ALGOL with extensions is used to describe the translators and other processors. The translator for this simpler system must be hand modified for a new computer system. The system is sufficiently simple so that this modification consists of changing tables and input-output routines.

371

California U. [Electronics Research Lab.] Berkeley.

AN OPTIMAL OPERATION OF COMMUNICATION NETS, by I. Cederbaum. [1962] [12]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340) Unclassified

Published in Jour. Franklin Inst., v. 274: 130-141, Aug. 1962.

An approach is presented to analysis of communication nets based closely on the theory of single-element-kind but not necessarily linear networks. The potential ability of networks to minimize some form of losses is applied to define an optimal operation of communication nets. The new element introduced in this approach is that it is capable of distributing the flow throughout the network by taking into account both the network topology and the capacities of individual edges. The method may be applied to rather general situations, such as simultaneous multi-node-pair communication with some relative priority weights attached to different pairs. On the computational side it shows a systematic way leading to the solution which may be programmed on a digital computer. (Contractor's abstract)

372

California U. [Electronics Research Lab.] Berkeley.

RELAXATION OSCILLATION NEAR THE THRESHOLD OF INSTABILITY IN YTTRIUM IRON GARNET, by S. Wang and G. E. Bodway. [1962] [3]p. incl. diagrs. (Bound with its AFOSR-5509) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-340) Unclassified

Published in Jour. Appl. Phys., v. 33: 3526-3528, Dec. 1962.

Coherent low-frequency relaxation oscillation in the amplitude of the z component of magnetization and the imaginary part of susceptibility has been observed in YIG at a microwave power level slightly above the threshold of instability. The relaxation time associated with the uniform mode has also been measured. The condition for coherent relaxation oscillation depends critically on the magnitude of the dc magnetic field. The low-frequency oscillation is interpreted to be the beat of 2 high-frequency components due to a split in the frequency of the k spin wave $\omega_k \pm \Delta\omega_k$. It is also believed that the period of oscillation is controlled by the relaxation time associated with the uniform mode. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

EXCHANGE NARROWED ESR ABSORPTION LINES AT LOW AND INTERMEDIATE FREQUENCIES, by J. R. Singer. [1962] [5]p. incl. diagrs. tables. (AFOSR-64-2328) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-117 and Army Research Office (Durham)) Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 577-581, 1963.

The electron spin resonance absorption spectra of DPPH recrystallized from benzene, acetone, methyl ethyl ketone, and selected other ketones were studied at various frequencies from 30 mc to 9 kmc with corresponding magnetic fields from 10 to 3200 gauss. Shifts in g-values

vs power input and vs various solvents are tabulated. The DPPH recrystallized from ketone solutions was found to have a much narrower line than normal DPPH similar to observations from DPPH recrystallized from chloroform solutions. One explanation for this stringy narrowed line is that DPPH recrystallized from benzene incorporates additional benzene rings into the lattice resulting in a decrease in the overlap of the electron wavefunction and a decreased exchange interaction. The DPPH recrystallized from the ketones has greater overlap of the wavefunction and a stronger exchange interaction. In addition, however, the line shapes of some of the crystals indicate a mixture of absorption spectra. This is borne out by a shift in the g values of these crystals, and an interesting variation of line width with r-f input power. At different field strengths and ESR frequencies, the ratios of the line widths between the ketone and benzene recrystallized DPPH change. In addition, the non-symmetrical line shapes indicate the possibility that the recrystallization occurs in several forms from the standpoint of the spin resonance absorption spectra. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

EXPERIMENTAL STUDY OF INITIAL FLAME ACCELERATION IN A SPARK IGNITED EXPLOSIVE GAS, by A. J. Laderman, P. A. Urtiew, and A. K. Oppenheim. Feb. 1962 [37]p. incl. illus. diagrs. refs. (Technical note no. DR 11) (AFOSR-2190) (AF 49(638)-165) AD 272980 Unclassified

The influence of the geometry of ignition on the initial flame acceleration in spark ignited, stoichiometric hydrogen-oxygen mixtures was investigated. Observations were made using schlieren photography with simultaneous pressure measurement in the vicinity of the ignitor. Distance between the point of ignition and the closed end (backwall) of the tube was varied over the range of limiting cases where (1) the flame was in continuous contact with the backwall to where (2) the flame contacted the sidewalls of the tube before reaching the backwall. It was found that flame acceleration increased with increasing backwall distance until condition 2 was satisfied, after which further increase in backwall distance had no effect. The slower flames associated with the smaller backwall distances were attributed to heat losses to the backwall. Experimental results were interpreted by analysis in which the 3 dimensional flame was considered to act as an equivalent plane flame. Flame acceleration and pressure history computed in this manner for cases 1 and 2 were in fair agreement with experimental observations. The total heat loss to the backwall for case 1 was estimated to be approximately 15% of the total heat release by chemical reaction, or 0.7 cal. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

INTERFEROMETRIC OBSERVATION OF FLAME ACCELERATION IN AN EXPLOSIVE GAS, by A. J. Laderman, P. A. Urtiew, and A. K. Oppenheim. Feb. 1962 [50]p. incl. illus. diagrs. tables, refs. (Technical note no. DR 12) (AFOSR-2191) (AF 49(638)166) AD 273684 Unclassified

Flash photographs of the transition from deflagration to detonation were obtained by means of the Mach-Zehnder interferometer. Experiments were performed using stoichiometric hydrogen-oxygen mixtures in a 1.0 by 1.5 in. detonation tube with 3 methods of ignition: spark discharge, pilot flame, and glow coil. In all cases the ignitor was located at the closed end of the tube. For each set of operating conditions, a series of flash interferograms were taken, 1 on each experiment, which were pieced together on a single time-space plane to yield a cinematographic representation of the process. The individual interferograms revealed considerable information on the shape of the flame front and on the structure of the reaction zone, while the sequence of photographs yielded an insight into the breakdown of the combustion front from a laminar to a turbulent flame. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

THE ONSET OF RETONATION, by A. K. Oppenheim, A. J. Laderman, and P. A. Urtiew. [1962] [5]p. incl. illus. diagrs. table. (AFOSR-J1081) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)166 and National Aeronautics and Space Administration) AD 420933 Unclassified

Also published in Combustion and Flame, v. 6: 193-197, Sept. 1962.

The purpose of this paper is to report on optical observations made recently that seem to unravel some of the mysteries still surrounding the formation of detonation in a gaseous medium. The onset of the retonation wave in a stoichiometric hydrogen-oxygen mixture contained in a 1 x 1.5 in. tube has been observed by means of schlieren streaks and instantaneous photographs. Some interesting details of transverse oscillation characteristics of spin which accompany this even have been revealed. Experimental record have been interpreted by means of a wave dynamic analysis to determine the state of the medium where the oscillations are set in. Their frequency has been found to be in agreement with the eigenvalue solution of the linear wave equation. It appears that the process has been initiated by a point explosion that is preceded by a deflagrative implosion. In this respect the phenomenon bears an interesting similarity to high frequency combustion instabilities in rocket thrust chambers, promising thus to serve as a useful tool for the study of their physicochemical aspects. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

DETERMINATION OF THE DETONATION WAVE STRUCTURE, by A. K. Oppenheim and J. Rosciszewski. [1962] [18]p. incl. diagrs. tables, refs. (AFOSR-J1086) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)166 and National Aeronautics and Space Administration) AD 420688 Unclassified

Also published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 424-441.

In order to investigate the influence of transport properties on the coupling between the shock and deflagration that may occur in a steady, plane detonation wave, the structure of the laminar detonation wave in ozone has been determined for 3 fundamental models: the coupled-wave, the von Neumann-Döring-Zeldovich model, and the decoupled deflagration wave. The results have been compared from th point of view of the approximation proposed by Spalding. The validity of the continuum treatment has been checked by evaluating the variation throughout the wave of the average number of intermolecular collisions per molecule of product. It appears from this that, although the theory may not be realistically close to the hot boundary, it is certainly quite reasonable in the regime of coupling between the shock and deflagration—the primary object of the investigation. In conclusion it is contended that only a thorough understanding of the so-called laminar wave structure can provide proper basis for the assessment of the effects of turbulence and other time dependent and multidimensional phenomena that may accompany the detonation process.

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California U. [Inst. of Engineering Research] Berkeley.

EFFECT OF IGNITION GEOMETRY ON INITIAL FLAME ACCELERATION IN A SPARK IGNITED EXPLOSIVE GAS, by A. J. Laderman, P. A. Urtiew, and A. K. Oppenheim. [1962] [11]p. incl. illus. diagrs. refs. (AFOSR-J1087) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)166 and National Aeronautics and Space Administration) AD 420643 Unclassified

Also published in Combustion and Flame, v. 6: 325-335, Dec. 1962.

The influence of the geometry of ignition on the initial flame acceleration in spark ignited, stoichiometric hydrogen-oxygen mixtures at n. t. p. was investigated experimentally. Observations were made using schlieren photography with simultaneous pressure measurements in the vicinity of the igniter. It was found that flame acceleration increased when the distance between the ignition source and the backwall became larger provided that the flame was in continuous contact with the backwall. When the ignition source was extended farther into the tube so that the flame contacted the sidewalls before reaching the back end, its acceleration became independent of the distance of the point of ignition from the backwall. Experimental results were interpreted quite satisfactorily by means of a one-dimensional gas wave dynamic analysis, demonstrating a significantly larger dependence of the flame acceleration process upon the normal burning velocity than on the net amount of heat released per unit mass. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

ON THE GENERATION OF A SHOCK WAVE BY FLAME IN AN EXPLOSIVE GAS, by A. J. Laderman, P. A. Urtiew, and A. K. Oppenheim. [1962] [19]p. incl. illus. diagrs. table, refs. (AFOSR-J1088) (AF 49(638)166) AD 420649 Unclassified

Also published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 265-274.

This paper provides experimental as well as theoretical proof that a laminar flame can generate a shock front quite early in the course of its initial acceleration. The flame at this stage of the process is wrinkled laminar, and it propagates at a velocity which is only a few times larger than the normal burning speed. However, no mechanism other than the break-up of the flame front into a cellular structure is necessary for this purpose, nor as it observed. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

SHOCK INTERACTION WITH AN ELECTROMAGNETIC FIELD, by J. Rosciszewski and A. K. Oppenheim. [1962] [10]p. incl. illus. diagrs. refs. (AFOSR-J1093) (AF 49(638)166) AD 421118 Unclassified

Also published in Phys. Fluids, v. 6: 689-698, May 1963.

The interaction between a traveling shock wave and a stationary magnetic field is analyzed for the simplest case of 1-dimensional flow across a rectangular system of a magnetic and an electric field, while the flowing substance is a plasma of finite conductivity but associated with a sufficiently small magnetic Reynolds number to render the induced magnetic effects negligible. The acceleration of the shock wave produced by a constant electric field applied across the duct walls in the presence of a perpendicular magnetic field as well as its attenuation due to a distributed system of outside resistances connecting a series of electrodes on the sidewalls of the duct, have been calculated by quadratures. The flow field behind the wave has been determined by means of a perturbation technique whose validity is restricted to cases of small Lorentz forces and moderate Joule heating effects. To gain more familiarity with the interaction process a hydraulic analog is proposed, based on the use of a piston driven, free surface, mercury channel. In this connection, a general solution is

consequently obtained for the interaction of a hydraulic jump traveling in a conducting liquid with a vertical magnetic field in the presence of a horizontal electric field. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

MEASUREMENT OF PRESSURE FIELD GENERATED AT THE INITIATION OF EXPLOSION, by A. J. Laderman, P. A. Urtiew, and A. K. Oppenheim. [1962] [4]p. incl. illus. diagrs. (AFOSR-J1149) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)166 and National Aeronautics and Space Administration) AD 423126 Unclassified

Also published in Symposium on Measurement in Unsteady Flow, Worcester, Mass. (May 21-23, 1962), New York, American Society of Mechanical Engineers, 1962, p. 32-35.

A record obtained by the use of a piezo-electric pressure gauge, substantiated with a schlieren photograph, permits a complete determination of the pressure field in the time-space domain during the initial phases of an explosion. The experiments were performed in a detonation tube of 1" x 1½" rectangular cross-section containing a stoichiometric mixture of hydrogen and oxygen. By correlating a single pressure record with a simultaneously obtained schlieren streak photograph, the character of the transient pressure profile observed ahead of an accelerating flame is established as one corresponding to a simple wave. The property of this wave is then used to transform the measured time variation of pressure at a fixed section in the tube to the distribution of pressure in space at any time. On this basis, the variation of the pressure profile with time and the collapse of the pressure fan into a shock wave is traced in detail. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

THIN FILM THERMOMETRY IN DETONATION RESEARCH, by A. J. Laderman, G. J. Hecht, and A. K. Oppenheim. [1961] [5]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)166 and National Aeronautics and Space Administration) Unclassified

Published in Temperature: Its Measurement and Control in Science and Industry; a Symposium, Columbus, Ohio (Mar. 27-31, 1961), ed. by A. I. Dahl. New York, Reinhold Publishing Corp., v. 3 (pt. 2): 943-947, 1962.

The present work concerns the development of thin film resistance thermometers for the measurement of detonation velocities, shock and flame velocities in the pre-detonation regime, and the local heat transfer rate to the walls of the detonation tube. Construction details of a thin film resistance thermometer which utilizes a ceramic backing rather than glass or quartz are described. Performance of the thermometer is shown to compare favorably with that of the glass- or quartz-backed instrument. Measurements at several positions along the detonation tube indicate that the time variations of the local heat transfer rates to the wall are nearly identical throughout the development of detonation. In addition, since the gauge responds to both shocks and flames, it represents a promising method for studying the development of the pressure wave preceding the flame during the transition to detonation.

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California U. [Inst. of Engineering Research] Berkeley.

SOLID PROPELLANT DRIVEN SHOCK TUBE, by J. Rosciszewski. [1962] [2]p. incl. diagr. (AF 49(638)-166) Unclassified

Published in ARS Jour., v. 32: 1426-1427, Sept. 1962.

A simple analysis of solid propellant driven shock tube is presented, and comparison with piston and combustion driven shock tubes is given. The analysis of the influence of specific heat ratio on velocity of sound behind the reflected shock wave is included. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

SHOCK WAVE STRUCTURE IN PARTIALLY IONIZED GASES, by M. S. Grewal. Doctoral thesis, May 1962 [67]p. incl. illus. diagrs. refs. (Rept. no. HE-150-198; series no. 132, issue no. 5) (AFOSR-2949) (AF 49(638)502) AD 277603 Unclassified

Also published in Jour. Fluid. Mech., v. 16: 273-284, Aug. 1963.

The structure of a shock wave in a partially ionized gas, which is in thermal non-equilibrium ahead of the shock wave, is investigated. A method is developed to solve this problem by separating it into 2 parts. First the structure of the shock wave associated with the mixture of ions and atoms, which are assumed to behave alike through the shock transition, is taken to be of the Mott-Smith form. Then the behavior of electrons as they pass through this ion-atom shock is analyzed. Using this method, calculations are made for the shock wave structure in partially ionized argon for Mach numbers equal to 8, 10 and 12, and for the values of the electron-ion temperature ratio ahead of the shock wave equal to 3, 5 and 8. An essential feature of the shock profiles is found to be the existence of a broad zone of elevated electron temperature ahead of the electron compression region, caused by high thermal conductivity in the electron gas.

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California U. Inst. of Engineering Research, Berkeley.

TRANSITION FLOW (A SURVEY OF EXPERIMENTAL RESULTS AND METHODS FOR THE TRANSITION REGIONS OF RAREFIED GAS DYNAMICS), by F. S.

Sherman Aug. 15, 1962 [63]p. incl. diagrs. refs. (Rept. no. HE-150-201; series no. 132, issue no. 7) (AFOSR-3984) (AF 49(638)502) AD 284480 Unclassified

A survey of experimental data in the transition regime of rarefied gas dynamics utilized to indicate the status of present experimental and theoretical capabilities and some areas of interest for future research. Successful correlation technique for subsonic transition flow data is given. The limitations of low-density wind tunnels are discussed and a suggestion for free-jet testing as a means of achieving higher Mach numbers and lower Reynolds numbers without excessive boundary-layer difficulties is put forth. Several characteristics of axisymmetric jets issuing from sonic orifices are reviewed in this context. Finally, a few selected instrumentation problems are reviewed and a plea is made for certain technological advances which would greatly ease the burden of the rarefied gas experimentalist. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

SPECTROSCOPIC STUDY OF RECOMBINATION IN A He PLASMA (Abstract), by F. Robben. [1962] [1]p. AF 49(638,502) Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 163, Feb. 28, 1963.

Recent work on ion-electron recombination has shown that a collisional-radiative mechanism leads to values of the recombination rate in good agreement with experiment. Absolute-intensity measurements have been made of all the lines of He emitted from a recombining plasma in the visible and near ultraviolet, from which the number densities of the various excited states of He have been calculated. These measurements are in excellent agreement with the collisional-radiative mechanism, and lead to values for the collisional de-excitation rate of an excited He atom, which is in good agreement with semi-classical calculations of the cross sections. The plasma is generated by passing He through a high-current electric arc, and then expanding it in a low-density wind tunnel. The fractional ionization of the plasma is about 2%, and the electron densities are in the range of 10^{13} per cm^3.

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California U. [Inst. of Engineering Research] Berkeley.

AN ALGORITHM FOR THE TRANSLATION OF ALGOL STATEMENTS, by W. M. Keese, Jr. and H. D. Huskey. [1962] [5]p. incl. tables. (AFOSR-64-2005) (AF AFOSR-62-156) AD 451225 Unclassified

Also published in Information Processing; Proc. of the Internat'l. Fed. for Information Processing Cong., Munich (Germany) (Aug. 27-Sept. 1, 1962), ed. by C. M. Popplewell. Amsterdam, North-Holland Publishing Co., 1963, p. 498-502.

This paper describes a simplified version of the translator portion of a 3-stage compiler, which handles virtually all ALGOL 60 statements of a static nature, not involving lists of recursiveness. The output is a machine-independent intermediate language, designed for efficient assembly into the particular language of any individual computer. The translator is aware, at any given moment, of no more than 4 entities from the source language. There is neither back-up nor look ahead. Translation occurs through the use of a push-down list of operators and associated addresses, the process being governed by a comparison of the strengths of the operators. This comparison is mainly effected by the numerical relationship of the internal representations of the operators, and usually occurs without having to determine the identity of either operator. The operation part of a command is normally generated by automatic manipulation of the responsible operator, again making it unnecessary to identify the operator. The complete ordering, representation, and placement lists on which automation of the process depends are given and the algebraic system is developed in detail. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

SUPERSONIC FLOW PAST WEDGES OF VARIABLE ANGLE, by M. Holt and B. Yim. [1962] [13]p. incl. diagrs. tables. (AFOSR-3139) (In cooperation with Brown U., Providence, R. I.) (AF 49(638)232 and AF AFOSR-62-277) AD 413747 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. 2: 1301-1313, 1962.

The problem of supersonic flow past a double wedge wing of constant chord and thickness varying along the span is considered. The major part of the paper is concerned with the flow field near the forward faces. This is a small rotational perturbation of uniform flow and the additional pressure satisfies the wave equation. The solution determining this flow field is derived in 2 cases corresponding to a variation of maximum thickness which is (a) linear, (b) sinusoidal in the spanwise coordinate. The flow problem near the forward faces can be reduced to that of finding the function defining the departure of the shock surface from its plane, 2-dimensional form (corresponding to a wedge of uniform thickness). In case (a) it is shown that the shock surface is wedge-like with a thickness proportional to that of the solid wedge. In each plane normal to the span the flow follows the 2-dimensional pattern. In case (b) an integrodifferential difference equation is derived for the shock distortion function. The solution of this is shown to exist and to be unique and is given in the form of a series expansion in chordwise distance from the shock. Formulae giving the pressure and velocity components in terms of the shock distortion function are derived. The pressure and chordwise velocity component on the surface are

computed for a range of wedge angles between 5° and 20° and Mach numbers between 3.0 and 4.2. The continuation of the flow field through the centered expansions at the shoulders and past the rear wedge faces is discussed. This can be calculated by a linearized method of characteristics which is much simpler in case (b) than in case (a). (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

THE DESIGN OF PLANE AND AXISYMMETRIC NOZZLES BY THE METHOD OF INTEGRAL RELATIONS, by M. Holt. Sept. 1962, 35p. incl. diagrs. refs. (Series no. 197; issue no. 1) (AFOSR-3140) (AF AFOSR-62-277) AD 288546 Unclassified

Also published in Symposium Transsonicum, Aachen (Germany) (Sept. 3-7, -962), ed. by K. Oswatitsch. Berling, Springer-Verlag, 1964, p. 310-324.

The method of integral relations due to Dorodnitsyn is applied to the problem of design of plane and axisymmetric nozzles. The inverse problem of calculating the flow field in a nozzle of given shape is also considered. The method is applied to plane nozzles so that results may be compared with earlier calculations by Cherry using the hodograph method. The extension of the analysis to cover axially symmetric flow is explained. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

CYLINDER DRAG IN THE TRANSITION FROM CONTINUUM TO FREE-MOLECULE FLOW, by G. J. Maslach and S. A. Schaaf. [1962] [18]p. incl. illus. diagrs. table, refs. (Rept. no. HE-150-194; series no. 20; issue no. 138) (AFOSR-3744) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 274385 Unclassified

Also published in Phys. Fluids, v. 6: 315-321, Mar. 1963.

The drag coefficients for cylinders normal to the flow have been determined experimentally at approximately Mach ~ 2, Mach ~ 4, and Mach ~6 with Knudsen numbers extending from continuum conditions to free molecule flow conditions. The results indicate a smooth transition from inviscid values at low Knudsen numbers to free molecule flow predictions for diffuse reflections at high Knudsen number. Small departure theories which are applicable to the near free molecule flow regime are compared to the experimental data. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

DIFFUSIVE SEPARATION OF A GAS MIXTURE APPROACHING A SAMPLING PROBE, by B. S. Masson Oct. 31, 1962, 57p. incl. diagrs. refs. (Rept. no. HE-150-206; series no. 20; issue no. 141) (AFOSR-4166) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 288657 Unclassified

The effect of inserting a probe into a flow field of a flowing gas mixture to obtain localized concentration measurements is considered. The diffusion mechanisms, due to the baro-diffusion and the thermal diffusion effects that cause the concentration variations in the original flow field, cause further changes in the mixture composition during the sampling process. The corrections in the measured composition due to the presence of the probe are calculated for a specific experiment using air as the gas mixture. The corrections are presented as curves for Mach numbers of the approaching stream between 0.1 and 0.4, and Reynolds numbers of the probe between 0.4 and 40. The corrections are based upon the numerical integration of the diffusion equation derived in the Chapman-Enskog Kinetic Theory. The fluid dynamic effects due to the composition change are ignored by using existing pure flow solutions in the flow model. Baro-diffusion is retained as the primary component-separating mechanism in the sampling region. The variation in the composition of the mixture along the stagnation streamline of the approaching flow is found. The total change in composition found here is taken as the correction desired for the probe presence. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

AERO-FORCES ACTING ON A BLUNT BODY WITH SEPARATED FLOW, by T. S. Yuen. Oct. 30, 1962, 50p. incl. illus. diagrs. tables, refs. (Rept. no. HE-150-203; series no. 20; issue no. 140) (AFOSR-4167) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 288656 Unclassified

Normal and axial force coefficients were calculated theoretically for a blunt body. Concurrently, aerodynamic forces acting on a model of the same body type were measured in a supersonic rarefied gas flow at a Reynolds number of 2260/in. and nominal Mach number of 4.0, so that the laminar separation was involved in the area bounded by the cylinder and cone. Two parameters were under consideration, the angle of attack varying from zero to 20°, and the position of the skirt relative to the tip of the central cylindrical body changing from z = 0.092 to 1.429 in. The experimental results, plotted in coefficient form, were compared to the theoretical predictions which consisted of Newtonian hypersonic theory with viscous corrections. The axial force coefficients based on the experimental data were within 3% of the predicted values at low angles of attack (less than 6°). The experimental normal force coefficients

were adequately predicted with a similar trend by the theoretical analysis with a maximum error of about 15% over the entire range of both angle of attack and center body position. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

ON THE MOLECULAR INTERACTIONS BETWEEN GASES AND SOLIDS, by F. C. Hurlbut. Nov. 15, 1962 [31]p. incl. diagr. tables, refs. (Rept. no. HE-150-208; series no. 20; issue. no. 142) (AFOSR-4981) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 295409 Unclassified

Also published in Symposium on Dynamics of Manned Lifting Planetary Entry, Philadelphia, Pa. (Oct. 1962), ed. by S. M. Scala, A. C. Harrison, and M. Rogers. New York, John Wiley & Sons, 1963, p. 754-777.

Problems of energy and momentum transfer between the gas particle and the surface are examined with attention given to those processes which directly influence the flow under free molecule and near free molecule conditions. A review of early and also very recent scattering studies reveals consistent trends in the reflected angular distribution in particle flux from cleaved and degassed alkali halide crystals and from certain degassed metal surfaces. These observations lend support to a dynamical model of the lattice in interaction with the gas particle. In connection with the discussion of this model three broad regimes of interaction in the presence of attractive forces are defined. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

HYPERSONIC FLOW OVER A SLENDER CONE WITH GAS INJECTION, by H. H. King. Nov. 5, 1962, 105p. incl. illus. diagrs. tables, refs. (Rept. no. HE-150-205. series no. 196; issue no. 1) (AFOSR-4985) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245; and General Electric Co.) AD 295154 Unclassified

The main object of the present study was the experimental investigation of the effect of gas injection on the drag and pressure distribution on a 5° half-angle porous cone. Both helium and air injection were employed at two Mach-Reynolds number combinations attainable in the Berkeley low density wind tunnel. The first part of the report presents a general discussion of the experiment, the experimental data obtained, and the comparison of these data with theory. Section 2 is a detailed discussion of the experimental procedure and the methods of data reduction, while Section 3 presents the approximate boundary layer analysis which is useful for interpreting the experimental data. A discussion of the accuracy of the various experimental results and tabulations of data appear in the Appendix. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

AN EXPERIMENTAL INVESTIGATION OF FREE MOLECULE MOMENTUM TRANSFER BETWEEN GASES AND METALLIC SURFACES by R. E. Stickney Doctoral thesis, Jan. 25, 1962, 145p. incl. illus. diagrs. tables, refs. (Rept. no. HE-150-182; series no. 20; issue no. 134) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 273495 Unclassified

Published in part in Phys. Fluids, v. 5: 1617-1624, Dec. 1962. (Title varies)

Measurements of the normal momentum transfer between gases and metallic surfaces were obtained under conditions of free molecule flow by means of a torsion balance and molecular beam apparatus. Helium, hydrogen, neon, nitrogen, argon, and carbon dioxide were investigated on tungsten, platinum-blackened-tungsten, platinum, and aluminum surfaces which were most likely contaminated with oxides and adsorbed gases. Momentum transfer measurements were obtained with the surface at various temperatures, the range being from 25 to 550°C. The efficiency of the momentum transfer process increases with the molecular weight of the test gas and the roughness of the test surface, but is relatively independent of the surface material under the present conditions. The momentum transfer rates for helium and hydrogen are significantly less than for the heavier gases. The accommodation to the surface temperature is incomplete except, possibly, for argon and carbon dioxide. The results were used to estimate the values of the coefficient of translational energy transfer and a modified form of the coefficient of normal momentum transfer. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

SPHERE DRAG IN A LOW-DENSITY SUPERSONIC FLOW, by J. Aroesty. [1962] [17]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under [Nonr-22245]) Unclassified

Published in Rarefied Gas Dynamic; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 2: 261-277, 1963. (AFOSR-5310)

Sphere drag coefficients were measured at Mach numbers of 2, 4, and 6, and free stream Reynolds numbers between 10 and 10,000 for both insulated and cold wall conditions. The measurements indicate that sphere drag in this regime is strongly dependent on the Reynolds number behind a normal shock wave, and only weakly dependent on Mach number. In addition, it was found that a decrease in T_w/T_0 from 1 to 0.26 was accompanied by a 5-10% decrease in the drag coefficient. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

STUDIES OF NORMAL MOMENTUM TRANSFER BY MOLECULAR BEAM TECHNIQUES, by R. E. Stickney and F. C. Hurlbut. [1962] [16]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under [Nonr-22245]) Unclassified

Published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 1: 454-469, 1963. (AFOSR-5310)

The transfer of normal momentum between gases and metallic surfaces has been studied under conditions of free molecular flow by means of a torsion balance and molecular beam apparatus. Thermal beams of helium, hydrogen, neon, nitrogen, carbon dioxide, and argon were directed against surfaces of tungsten, platinum blackened tungsten, platinum and aluminum with surface temperatures in the range 25° to 550°C. The efficiency of momentum transfer is found to increase with the molecular weight of the test gas and the roughness of the test surface, but is relatively independent of the substrate material, under present conditions. The momentum transfer rates for helium and hydrogen are significantly equal. The momentum accommodation of the test gases appears to be incomplete except, possibly, for argon and carbon dioxide. The results are used to estimate the value of a modified coefficient of momentum transfer for each gas-surface combination. (Contractor's abstract)

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California U. Materials Research Lab., Berkeley.

THE EFFECT OF GRAIN BOUNDARIES ON THE MECHANICAL PROPERTIES OF IONIC CRYSTALS, by S. Feuerstein and E. R. Parker. Jan. 1962 [63]p. incl. illus. diagrs. table, refs. (Technical rept. no. 5; series no. 150; issue no. 5) (AFOSR-2169) (AF 49(638)-601) AD 273425 Unclassified

Room temperature tensile tests were conducted on single crystal, bicrystal, and polycrystalline LiF. Their mechanical behaviors were compared and the effects resulting from the presence of grain boundaries evaluated. The fracture processes of single crystal and bicrystal specimens were also investigated. Favorably oriented, chemically-milled single crystals attained tensile strains as high as 27% before failing. Ductile fractures resulted from internal sources, but fractures from low strains were due to surface sources. Stress-strain curves of bicrystals indicated that grain boundaries in ionic crystals were not inherently weak. Plastic deformation in at least one grain always preceded fracture. The presence of a grain boundary afforded a strong barrier to dislocation motion, becoming more effective the greater the degree of bicrystal misorientation. Evidence of slip lines on only one side of matching intergranular surfaces revealed that transmission of slip across a grain boundary was difficult. Failures took place in a brittle fashion predominantly along an inter- and transgranular path. Strains at fracture seldom exceeded 2-1/2%. Small amounts of ductibility were observed in deformed, fine-grained polycrystalline specimens. A sharp rise in fracture stress was apparent in specimens whose average grain diameters approach 0.02 millimeters. (Contractor's abstract)

399

California U. Materials Research Lab., Berkeley.

DUCTILE CERAMICS RESEARCH, by E. R. Parker, J. A. Pask, and J. Washburn. Final rept. Aug. 1962, 6p. incl. refs. (Series no. 150; issue no. 6) (AFOSR-3502) (AF 49(638)601) AD 283585 Unclassified

Work was confined to studies of cubic crystal ductility. Such material is highly ductile at room temperature when tested in single crystal form. Surface effects are extremely important and good ductility can be obtained only with specimens having carefully prepared chemically polished surfaces. It was found that MgO single crystals are ductile at room temperature and values of elongation in excess of 10% were obtained regularly. Alloying of ionic solids increased their strength. Recent work concerned grain boundary effects on the ductility of ionic solids; experiments indicated the smaller the grain size, the higher the strength, and the greater the probability of significant deformation before fracture. High purity is essential. Extrusion was chosen as a means of fabricating fine-grained LiF and slightly ductile specimens were obtained.

400

California U. [Materials Research Lab.] Berkeley.

FRACTURE OF NONMETALLIC CRYSTALS, by T. L. Johnston and E. R. Parker. [1962] [21]p. incl. illus. diagrs. refs. (AF 49(638)601) Unclassified

Published in Fracture of Solids: Proc. Internat'l. Conf., Maple Valley, Washington (Aug. 21-24, 1962), ed. by D. C. Drucker and J. J. Gilman. New York, Interscience Publishers, 1963, p. 267-287.

Investigations with nonmetallic crystals have been more fruitful than those with metals in revealing the role played by dislocations in initiating cracks. There is clear experimental evidence that cracks can form in a number of ways as a consequence of heterogeneous plastic flow. It has been demonstrated that the applied stress required to form a crack at the grain boundary in a magnesium oxide bicrystal depends inversely on the distance between the grain boundary and the nucleation site of the glide band causing the crack, as suggested by theory. The choice of nucleation mechanism and the amount of deformation preceding fracture is associated phenomenologically with the character of slip band formation which is governed primarily by the temperature. Although single nonmetallic crystals can often be deformed readily at low temperatures, polycrystalline aggregates are notably more brittle. Recent experiments with lithium fluoride have shown that, under certain conditions, even polycrystalline material can possess limited tensile elongation at room temperature (values in excess of 1/2% have recently been obtained).

401

California U. [Materials Research Lab.] Berkeley.

PLASTIC FLOW AND FRACTURE OF CRYSTALLINE SOLIDS (Abstract), by E. R. Parker. [1962] [1]p. (AF 49(638)601) Unclassified

Presented at Sixty-fourth annual meeting of the Amer. Ceram. Soc., New York, Apr. 29-May 3, 1962.

Published in Bull. Amer. Ceram. Soc., v. 47: 217, Apr. 1962.

A brief review of recent work on the strength of solids, discussing dislocation theory, strain hardening, recovery, creep and fracture is presented. The application to non-metallic crystals and the possible results therefrom are indicated.

402

California U. [Materials Research Lab.] Berkeley.

INTERNAL STRESSES IN MODEL CERAMIC SYSTEMS III, by R. M. Fulrath and J. A. Pask. Final rept. Nov. 1, 1962, 15p. incl. refs. (Series no. 119; issue no. 3) (AFOSR-4439) (AF 49(638)4) AD 291849 Unclassified

A unique fabrication procedure of vacuum hot-pressing multicomponent systems was used to form model ceramic systems for studying internal stresses. Methods of analysis of internal stress combining the microstructural features and x-ray diffraction patterns were developed. Three different particle shapes dispersed in glassy matrices were studied. Internal stresses were found to be of secondary importance in systems with strong interfacial bonds and of primary importance in systems in which strong interfacial bonds were not developed.

403

California U. [Minerals Research Lab.] Berkeley.

HEAT CONTENT OF PLATINUM, by R. Hultgren, W. B. Kendall, and R. L. Orr. [1962] [3]p. incl. diagrs. tables, refs. (Materials Science Series Contribution no. 149; I. E. R. Reprint no. 10-63) (AFOSR-J342) (AF 49(638)83) AD 408022; AD 404959 Unclassified

Also published in Jour. Chem. and Eng. Data, v. 7: 515-518, Oct. 1962.

Chemical inertness, high melting point, and freedom from allotropic and magnetic transformations give platinum obvious advantages as a secondary standard for calibrating high-temperature calorimeters. However, currently accepted tables of the heat content of platinum can be criticized because the values below 500°K are too high to join smoothly with reliable low-temperature (< 298°K) heat capacity data, and because the tables are based mainly on the drop calorimetry of Jaeger and others in which the heat lost by the sample during the drop was not properly taken into account. The performance of a diphenyl ether calorimeter used in the laboratory is routinely checked by dropping samples of platinum. The results so obtained scatter considerably more than those by Jaeger and others from larger samples, but they do show clearly that the over-all systematic error in Jaeger's work is very small. They also show the previously tabulated heat contents at 400° and 500°K are somewhat too high. (Contractor's abstract)

404

California U. School of Public Health, Berkeley.

SOME OBSERVATIONS ON THE PHYSIOLOGICAL EFFECTS OF GASEOUS IONS, by A. P. Krueger, S. Kotaka, and P. C. Andriese. [1962] [16]p. incl. diagrs. tables, refs. (AFOSR-J264) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-669 and Public Health Service) AD 400888; AD 416072 Unclassified

Also published in Internat'l. Jour. Biometeor., v. 6: 33-48, 1962.

This paper reviews some of the evidence pertaining to the biological effects of gaseous ions. It appears that experimental data now available warrant the conclusion that reproducible biological effects occur in a variety of living forms including microorganisms, higher plants, insects, animals and man. The responses generally are limited in extent and to indict air ions as their sole cause requires great care in defining the experimental conditions. Some progress has been made in detecting the fundamental biochemical reactions associated with ion-induced physiological changes. The ready availability of excellent apparatus for generation and measurement of air-ions, coupled with present day knowledge about their properties, makes critical experimentation possible. (Contractor's abstract)

405

California U. [Seismographic Station] Berkeley.

COMPUTER LOCATION OF LOCAL EARTHQUAKES WITHIN THE BERKELEY SEISMOGRAPHIC NETWORK, by B. A. Bolt and T. Turcotte. [1962] [15]p. incl. diagrs. (AF 49(638)904) AD 439072 Unclassified

Also published in Computers in the Mineral Industries: Proc. Third annual Conf., Stanford U., Calif. (June 24-29, 1963), ed. by G. A. Parks. Stanford, School of Earth Sciences, Pt. 2: 561-576, 1964.

Since 1887 the Berkeley seismographic station has been used for the study of earthquake occurrence in central and northern California. The present network consists of some 20 stations in California and Nevada. Eight new stations telemeter signals directly to Berkeley. The present network allows a much more precise determination of the position and origin-time of earthquakes within the region than previously possible. Measurements of the main recorded seismic phases are placed by station staff directly onto Hollerith format sheets. A program has been coded for an IBM 7090 which sorts out the travel-times from a provisional earthquake focus

to each station for the main observed phases. A 2-layered crust is assumed based on earlier work by Byerly; the layer parameters may be varied at will. One run of the program can accommodate data from as many as 50 stations for any number of earthquakes. It uses only P-wave arrival times, but computes also theoretical times for the various S-wave arrivals for the assumed structure. (Contractor's abstract)

406

California U., Davis.

THE INTERSECTION OF FIBONACCI SEQUENCES, by S. K. Stein. [1962] [4]p. (AFOSR-J530) (AF AFOSR-62-299) AD 407872 Unclassified

Also published in Michigan Math. Jour., v. 9: 399-402, 1963.

For the construction of a groupoid satisfying the identity $a((a \cdot ba)a) = b$ but not the identity $(a(ab \cdot a))a = b$, it was necessary to examine the intersection of Fibonacci sequences. If n is a positive integer and $F_1, F_2 \ldots, F_s$ are Fibonacci sequences, then there is an integer $m > n$ such that $\bar{F}(n, m) \cap \bar{F}_i$ consists of at most the element n, for each $i = 1, 2, \ldots s$. It is proven that 2 Fibonacci sequences generally do not meet and that if they do meet at least 3 times, then one is simply the tail of the other.

407

California U., Davis.

FINITE MODELS OF IDENTITIES, by S. K. Stein. [1962] [7]p. [AF AFOSR-62-259] Unclassified

Published in Proc. Amer. Math. Soc., v. 14: 216-222, Apr. 1963.

If Φ is a set of identities on a groupoid (a set closed under a binary operation), the $nV(\Phi)$ denotes the variety, i.e., the class of groupoids, satisfying Φ. A number-theoretic construction is used to exhibit an infinite with a nontrivial $V(\Phi)$ which has only one finite member. Another type of example shows that with Φ consisting of just one identity, varieties can be constructed which, though possessing an infinite set of finite members, are not determined by them. These latter examples are based upon identities obtained by equating compositions of so-called translations, that is, mappings $R_a : x \to xa$ and $L_a : x \to ax$. (Math. Rev. abstract)

408

California U. [Dept. of Physics] La Jolla.

DIFFICULTY IN THE METHOD OF GREEN'S FUNCTIONS FOR A MANY-BODY SYSTEM, by R. Ballian, L. H. Nosanow, and N. R. Werthamer. [1962] [4]p. incl. refs. (AFOSR-2559) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-1038 and Atomic Energy Commission) Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 372-375, May 1, 1962.

The method of Green's functions based on the infinite set (S) of coupled equations (with boundary conditions) satisfied by the sequence of n-particle Green's functions, has been used extensively in the theory of superconductivity. It has been shown, by solving an example exactly that (S) may possess spurious solutions, some of which lead to an energy lower than the true ground-state energy and so do not correspond to any state wave function. Thus the Green's function method as usually formulated is not a complete dynamical description of the system, and requires in addition some criterion to distinguish these extraneous solutions from the correct one. This work was developed in order to choose between the contradictory theories of the possible superfluid phase of He^3.

409

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY WITH COMBINED PARALLEL AND ANTIPARALLEL SPIN PAIRING, by N. R. Werthamer, H. Suhl, and T. Soda. [1962] [3]p. incl. refs. (AFOSR-3661) (AF 49(638)1038) Unclassified

Also published in Proc. Eighth Internat'l. Conf. on Low Temperature Phys., London (Gt. Brit.) (Sept. 16-22, 1962), Washington, D. C., Butterworths, 1963, p. 140-142.

In this paper the conditions on the interparticle potential are relaxed and the superconducting phase is investigated when allowing pairs with both even and odd angular momentum, and correspondingly both singlet and triplet spin states. Because of the presence of pairs with parallel spins, the paramagnetic ground state exhibits a nonvanishing spin susceptibility, and also is free from undesirable circulation orbital currents. Although a variety of formalisms exist in which to generalize the spin pairing in superconductors, the most convenient and compact seems to be that using Green's functions.

410

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY NEAR IMPURITIES, by H. Suhl, D. R. Fredkin and others. [1962] [3]p. incl. refs. (AFOSR-3662) (AF 49(638)1038) AD 612340 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 63-65, July 15, 1962.

Resonant scattering of conduction electrons by transition element impurities in dilute solid solution, and localization of a magnetic moment around the impurity can lead to a localized region of coherent pairing of electrons. In this report, the author speculates that resonance effects could also lead to a similarly localized region of coherent pairing of electrons. A model is considered in which the impurity potential is strongly

localized (has a constant matrix element) and the one-electron conduction band is characterized by a single peak in its density-of-states curve.

411

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY NEAR IMPURITIES, by D. R. Fredkin, J. S. Langer and others. [1962] [2]p. (AFOSR-3663) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1038 and National Science Foundation) Unclassified

For abstract see item no. 410, Vol. VI

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California U. [Dept. of Physics] La Jolla.

ENHANCEMENT OF HYDRODYNAMIC STABILITY BY MODULATION, by R. J. Donnelly, F. Reif, and H. Suhl. [1962] [3]p. incl. diagrs. (AFOSR-J105) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1038 and Office of Naval Research) AD 400465 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 363-365, Nov. 1, 1962.

A rotating cylinder viscometer, with metal cylinders, and filled with CCl_4 was built, in which the inner cylinder rotates and an electrical bias can be applied to a short insulated section of the outer cylinder. This outer cylinder can be moved axially so that the distribution of velocity in the liquid can be studied as a function of the current collected by the electrode at the particular axial position, the motion of the fluid producing changes in the current which also depends on the mobility of the ion species present and their diffusion constants. The speed of the inner cylinder can be modulated by sinusoidal variation about a controlled steady speed and conditions of modulation were determined which show a marked enhancement of stability. It is suggested that this method might be applied to boundary-layer control.

413

California U. [Dept. of Physics] La Jolla.

A NOTE ON THE SHORT-RANGE ORDER AT THE FERROMAGNETIC CURIE POINT, by D. R. Fredkin and H. Suhl. [1962] [2]p. (AFOSR-J590) (AF 49(638)-1038) AD 413749 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 217-218, Feb. 1963.

Ordinary thermodynamic fluctuation theory, which assumes a Gaussian fluctuation ensemble, leads to complete ordering of a Heisenberg ferromagnet at the Curie point. It is shown that a simple extension of the usual theory, utilizing Landau's phenomenological theory of second-order phase transitions, remedies this difficulty. The relation of this approach to molecular field theory is discussed.

414

California U. Dept. of Physics, La Jolla.

SOME CONDITIONS FOR THE APPARENT VANISHING OF THE ENERGY GAP IN SUPERCONDUCTORS, by H. Suhl and D. R. Fredkin. [1962] [4]p. (AFOSR-J592) (AF 49(638)1038) AD 414134 Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 131-134, Feb. 15, 1963.

A perturbation treatment is used to explain the apparent disappearance of the energy gap in superconductors observed by Reif and Woolf, in tunneling experiments where one of the superconducting films contains paramagnetic impurities.

415

California U. [Dept of Physics] La Jolla.

SATURATION OF FERRIMAGNETIC RESONANCE WITH PARALLEL PUMPING (Abstract), by F. Gottlieb and H. Suhl. [1962] [1]p. [AF 49(638)1038] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 279, Apr. 23, 1962.

The microwave susceptibility for subsidiary ferrimagnetic resonance with parallel pumping is calculated from the saturation amplitude of the unstable spinwaves. The saturation is caused by the nonlinear damping effects of the three, four, and higher-number magnon interactions. The rate of energy dissipation due to these interactions is proportional to the amplitude of each magnon participating: if two or more magnons belong to the unstable group, the dissipation rate will be nonlinear in the unstable spin-wave amplitude. The requirement that two or more of the magnons be of the same frequency can only be satisfied below a certain dc magnetic field. As the order of the interaction (number of participating magnons) increases, the strength of the interaction decreases, but the limiting upper field increases so that each of these interactions is important for a specific range of dc magnetic field, and this gives rise to a step-shaped curve for the susceptibility. The location of these steps as a function of magnetic field is found to agree with the experimental results of Hartwick and Peressini.

416

California U. [Dept. of Physics] La Jolla.

[FERROELECTRICITY, FERROMAGNETISM AND SUPERCONDUCTIVITY IN SOLIDS], by B. T. Matthias. Final rept. Apr. 1962, 9p. (AFOSR-2571) (AF 49(638)-1040) AD 286354 Unclassified

A laboratory for the study of cooperative phenomena in solids (superconductivity, ferromagnetism, ferroelectricity) was established, equipped and staffed. A number of active research programs are underway, and the scientific results of one of these (superconductivity in the Hg-In system) are summarized. (Contractor's abstract)

417

California U. [Dept. of Physics] La Jolla.

PHOTOELASTIC METHOD FOR HIGH SENSITIVITY DIFFERENTIAL DILATOMETRY, by M. F. Merriam. [1962] [6]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-1040 and Office of Naval Research) Unclassified

The purpose of this note is to call attention to a novel photoelastic method for differential dilatometry. The method has been used only on NaCl, but should be practical for many optically transparent crystals and glasses for which certain elastic and photoelastic constants are known. Extension to opaque materials is possible.

418

California U. Dept. of Physics, La Jolla.

THE SECOND ORDER EFFECT OF APPLIED ELECTRIC FIELDS ON THE ELECTRON SPIN RESONANCE OF IMPURITY IONS IN Al_2O_3 AND IN MgO (Abstract), by M. Weger and E. Feher. [1962] [1]p. (AF 49(638)1040) Unclassified

The first order Stark effect of the Cr^{+++} ions in Al_2O_3 has been first observed in the $\frac{3}{2} \rightleftharpoons \frac{1}{2}$ transitions by Arumen and Murphy. The second order Stark effect in the $\frac{1}{2} \rightleftharpoons \frac{1}{2}$ transition of Cr^{+++} in Al_2O_3 and in MgO was observed. The effect exhibits itself as a shift in the electron spin resonance line, proportional to the electric field squared. The shifts were estimated by modulating the electric field and comparing the signal with the one obtained with magnetic field modulation. The signal obtained with a field modulation of 10^5 v/cm had the same amplitude as was obtained with magnetic field modulation of 100 milligauss for Cr^{+++} in Al_2O_3 and of 4 milligauss for Cr^{+++} in MgO. The second order Stark effect was also observed in the resonance spectrum of Fe^{+++} and Mn^{++} in MgO. The experiments were performed at 10^{10} cps and at 300°K.

419

California U. [Dept. of Physics] La Jolla.

EFFECTS OF STRAIN ON THE SUPERCONDUCTING TRANSITION IN THE MERCURY-INDIUM SYSTEM, by M. F. Merriam and M. A. Jensen. [1962] [8]p. incl. diagrs. (AFOSR-J579) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-344 and National Science Foundation) Unclassified

Also published in Cryogenics, v. 2: 301-304, Sept. 1962.

Investigating superconductivity in the Hg-In system, it was found that the superconducting transition temperature can be increased considerably by strain. Under the most favorable conditions, this increase is more than 1°K. The most important condition for a large increase in superconducting transition temperature (T_c) to occur is that the sample has a composition corresponding to a 2-phase or solid solution region of the phase diagram. The increase in T_c is very small for the 2 intermetallic compounds in this sytem, as well as for pure Hg and In.

420

California U. [Dept. of Physics] La Jolla.

THE SECOND ORDER EFFECT OF APPLIED ELECTRIC FIELDS ON THE ELECTRON SPIN RESONANCE OF IMPURITY IONS IN MgO, by M. Weger and E. Feher. [1962] [6]p. incl. illus. (AFOSR-64-0749) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-344 and National Science Foundation) AD 436510 Unclassified

Also published in Paramagnetic Resonance; Proc. of First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 629-633, 1963.

A second order Stark effect has been observed in the EPR spectrum of Cr^{3+}, Mn^{2+}, Fe^{3+}, and Co^{2+} in MgO. The effect manifests itself as a shift in the resonant frequency of the absorption line, which is proportional to the square of the applied electric field. The observed shifts are small, of order 10 milligauss at 10000 v/cm, and are detected by a modulation technique. The possible origin of these shifts is discussed. (Contractor's abstract)

421

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY IN SOME MERCURY COMPOUNDS WITH FEWER THAN TWO VALENCE ELECTRONS PER ATOM (Abstract), by M. F. Merriam. [1962] [1]p. [AF AFOSR-62-344] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 474, Aug. 27, 1962.

Superconductivity has not been found so far in elements with fewer than two valence electrons per atom. In order to determine whether this situation can be correlated simply with a deficiency of valence electrons or whether other variables are more important, several compounds of Hg with alkali metals and noble metals have been studied for superconductivity. The superconducting transition temperatures of the compounds of mercury with any given element decrease monotonically with decreasing electron concentration; other chemical variables (structure, volume per electron, etc.) appear less important. Superconducting transition temperatures fall below 1°K at about 1.5 valence electrons per atom. The following approximate transition temperatures were obtained: Hg_4Na, 3.0°K; Hg_2Na, 1.6°K; Hg_3Li, 1.8°K; and Hg_4Pt, 3.5°K. Compounds found not superconducting at 1.1°K included Hg_2Na_3, Hg_2Pt, and $Hg_{0.57}Ag_{0.43}$ (γ-brass phase).

422

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY IN THE Pd-As SYSTEM AND THE EFFECT OF FERROMAGNETIC ADDITIONS (Abstract), by C. T. Raub, G. W. Webb, and R. W. Fitzgerald. [1962] [1]p. [AF AFOSR-62-344] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 474, Aug. 27, 1962.

Superconductivity has been observed in the Pd-As system near the composition of Pd_2As. The transition temperatures were also measured in alloys of either Co or Ni.

423

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY IN THE SYSTEM MERCURY-INDIUM (Abstract), by M. F. Merriam and M. A. Jensen. [1962] [1]p. [AF AFOSR-62-344] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 176, Mar. 26, 1962.

Alloys covering the composition range from pure Hg to 85 at. % In have been prepared by quenching the melt in liquid nitrogen from 200-250°C. Superconductivity was detected by measuring the self-inductance of a coil containing the specimen and was observed at all compositions. Transition temperatures ranged from below 3.2°K for 20 at. % In to above 6.0°K for 80 at. % In, and varied strongly as a function of composition. A single, reasonably sharp, superconducting transition was taken as indication of a homogeneous composition. Transition widths varied from a few hundredths to a few tenths of a degree.

424

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITIES NEAR IMPURITIES, by D. R. Fredkin, J. S. Langer and others. [1962] [2]p. (AFOSR-65-1190) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-64-631] and National Science Foundation) AD 620480 Unclassified

Also published in Proc. Eighth Internat'l. Conf. on Low Temperature Phys., London (Gt. Brit.) (Sept. 16-22, 1962), Washington, D. C., Butterworths, 1963, p. 157-158.

The influence of a charged, non-magnetic impurity, exerting a very short range self-consistent potential, on the coherent pairing of electrons is examined, using a Green's function method. It is found that a local superconducting solution can exist only for attractive electron-electron interactions.

425

California U. Inst. of Geophysics and Planetary Physics, La Jolla.

PRESSURE VARIATIONS ACCOMPANYING A PLANE WAVE PROPAGATED ALONG THE OCEAN BOTTOM, by H. Bradner. [1962] [3]p. incl. diagrs. (AFOSR-4382) (Sponsored jointly by Advance Research Projects Agency and Air Force Office of Scientific Research under AF 49(638)905) AD 295963 Unclassified

Also published in Jour. Geophys. Research, v. 67: 3631-3633, Aug. 1962.

The use of pressure transducers instead of seismographs on the ocean floor has been suggested as a way to detect small vertical bottom motions. The following valid argument has been used to estimate the ratio, in the limiting case of waves that are long compared with the water depth; the water above a given section of the bottom rises and falls as a cylinder. The pressure variations will then be just the force required to accelerate a column of water of length equal to the ocean depth. The ratio of pressure to velocity for other cases than the long wavelength limit is estimated by looking at the solution for plane wave propagation in a uniform liquid layer above a semi-infinite uniform solid bottom.

426

California U. [Inst. of Geophysics and Planetary Physics] La Jolla.

COMPARATIVE SPECTRA OF MICROSEISMS AND

SWELL, by R. A. Haubrich, W. H. Munk and F. E. Snodgrass. [1962] [11]p. incl. diagrs. refs. (AFOSR-J251) (AF 49(638)905) AD 400864 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 27-37, Jan. 1963.

Spectra of seismic and ocean wave recordings near San Diego, Calif., show closely related features. The wave spectra consist of a sharp peak whose frequency, f(t), increases linearly with time and consistent with the expected dispersive behavior from a source at 6150 nautical mi (presumably a storm in the Ross Sea). The seismic spectra show peaks at f(t) and at 2 f(t); the double frequency peak contains 100 times the energy of the peak at the primary frequency. A comparison between the peak frequencies and band widths of the seismic and ocean wave spectra, and an estimate of the direction and beam width of the seismic radiation leads to the following conclusions: that the microseismic generation area is predominantly local, being confined to distance of 100 mi up or down the coast. For the primary frequencies the generative strip is presumably confined to shallow water; for the double frequencies it extends 200 mi seaward.

427

California U. Inst. of Geophysics and Planetary Physics, La Jolla.

PROBING SEA-BOTTOM SEDIMENTS WITH MICRO-SEISMIC NOISE, by H. Bradner. [1962] [4]p. incl. diagrs. table. (AFOSR-J400) (AF AFOSR-62-420) AD 407881 Unclassified

Also published in Jour. Geophys. Research, v. 68: 1788-1791, Mar. 15, 1963.

Simultaneous measurements of the fluctuating pressure just above the sea bottom and of the vertical velocity of the sea bottom can provide information on the character and thickness of sediments, since the magnitude of pressure variation on the ocean bottom, generated by a passing Rayleigh wave is a function of the frequency and phase velocity of the Rayleigh wave.

428

California U. [Brain Research Inst.] Los Angeles.

EFFECTS OF LSD-25, PSILOCYBIN, AND PSILOCIN ON TEMPORAL LOBE EEG PATTERNS AND LEARNED BEHAVIOR IN THE CAT, by W. R. Adey, F. R. Bell, and B. J. Dennis. [1962] [12]p. incl. illus. diagrs. refs. (AFOSR-J1060) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686 and Public Health Service) AD 420289 Unclassified

Also published in Neurology, v. 12: 591-602, Sept. 1962.

With 25 to 100 μg of LSD-25 cats adopted a wide-based "kangaroo" posture with tail extended, and exhibited staring, head shaking and sprawling with claws extended. There was a loss of normal affective response. With LSD-25 dosage around 25 μg per kg brief seizure-like episodes were seen in EEG records in a quiet environment. These seizures seemed critically dependent on reduction of visual and auditory sensory influences. At higher doses of LSD-25 (around 100 μg per kg) seizures persisted in well-lit environments and disrupted a delayed response performance. Tolerance of LSD-25 appeared with frequently repeated doses (intervals less than 7-10 days). Psilocybin and psilocin resembled LSD-25 in general effects but differed in the brevity of their action and the frequency of severe autonomic reactions (vomiting, pupillary dilatation, etc.). These findings and their relation to physiologic mechanisms in the memory trace and to problems of sensory deprivation are discussed.

429

California U. Brain Research Inst., Los Angeles.

SELF-MAINTAINED VISUAL STIMULATION IN MONKEYS AFTER LONG-TERM VISUAL DEPRIVATION, by R. H. Wendt, D. F. Lindsley and others. [1962] [2]p. incl. diagr. (AFOSR-J1065) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686 and Public Health Service) AD 419439 Unclassified

Also published in Science, v. 139: 336-338, Jan. 25, 1963.

Newborn monkeys reared in darkness for 16 months, except for daily 1-hr periods of exposure to unpatterned light, were allowed to press a lever to obtain unpatterned light. The animals showed apparently insatiable responding, at rates that were extremely high as compared with rates for normally reared control animals. (Contractor's abstract)

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California U. [Brain Research Inst.] Los Angeles.

SPECTRA AND AVERAGE SHAPES OF SLOW WAVES IN THE HIPPOCAMPAL SYSTEM DURING TRAINING (Abetract), by D. O. Walter. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686 and Public Health Service) Unclassified

Presented at Forty-fifth annual meeting of the Fed. of Amer. Soc. for Exper. Biol., Atlantic City, N. J., Apr. 10-14, 1961.

Published in Fed. Proc., v. 20: 335, Mar. 1961.

The objective evaluation of EEG data by machine computation was utilized by Adey, Dunlop and Hendrix in auto- and cross-correlating slow waves seen in training records from regions of the hippocampal system. The present study includes auto- and cross-spectra, phase angles and coherence of similar data. These functions are applied in confirming those authors' result that hippocampal entorhinal phase angles differ in early vs late stages in acquisition of a conditioned discrimination. They are now shown to differ during correct vs incorrect responses, at the same stage. An

analytic method, suggested by Remond, has also been applied, which times the sampling of each EEG channel by upward zero-crossings of a chosen channel. With this technique evidence has been sought for a pace-maker of varying period, producing rhythmic phenomena in separate regions of the hippocampal system. Since this method retains harmonic relations within each trace, it has allowed an extension and clarification of the "phase-comparator" action proposed for rhinencephalic structures by the above authors. (Contractor s abstract)

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California U. Brain Research Inst., Los Angeles.

BRAIN FUNCTION. VOL. II. RNA AND BRAIN FUNCTION; MEMORY AND LEARNING, PROCEEDINGS OF THE SECOND CONFERENCE, Los Angeles, Calif., 1962, ed. by M. A. B. Brazier, Berkeley and Los Angeles, California U. Press, 1964, 360p. incl. illus. diagrs. tables, refs. (UCLA Forum in Medical Sciences no. 2) (AFOSR-65-1499) (AF AFOSR-61-77) Unclassified

The UCLA Forum in Medical Sciences was created to review, synthesize and analyze topics, from various areas of biology, chemistry and physics to applied medical arts. This second volume deals with the exploration of brain mechanisms underlying the phenomena of learning and memory, with particular reference to the contrast between information storage in genetic and in memory processes. The state of nucleic acid coding in genetics was reviewed, earlier efforts to identify such a nucleic acid base for information storage and retrieval in the nervous system was re-examined, and an attempt was made to evaluate the justification for carrying over some of the advances in genetic coding to the processes of learning and memory.

432

California U. [Brain Research Inst.] Los Angeles.

POTENTIAL FOR TELEMETRY IN THE RECORDING OF BRAIN WAVES FROM ANIMALS AND MEN EXPOSED TO THE STRESSES OF SPACE FLIGHT, by W. R. Adey. [1962] [14]p. incl. illus. diagrs. (AFOSR-5345) (AF AFOSR-61-81) AD 421749 Unclassified

Published in Bio-Telemetry; Proc. of Interdisciplinary Conf. on the Use of Telemetry in Animal Behavior and Physiology in Relation to Ecological Problems, New York (Mar. 28-31, 1962), ed. by L. E. Slater. New York, Pergamon Press, 1963, p. 289-302.

The feasibility of EEG telemetry from animals and men in space flight is discussed. Prime consideration is given to the development of an appropriate implantation technique to permit recording from deep brain waves, development of special hardware for the EEG recording, special testing involved in the environmental aspect of centrifuging and shaking during recording, and data analysis in flight to minimize telemetry.

433

California U. Brain Research Inst., Los Angeles.

EEG IN SIMULATED STRESSES OF SPACE FLIGHT WITH SPECIAL REFERENCE TO PROBLEMS OF VIBRATION, by W. R. Adey, W. D. Winters and others. [1962] [16]p. incl. illus. table, refs. (AFOSR-5346) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-81 and National Aeronautics and Space Administration) AD 421729 Unclassified

Presented at meeting of the Amer. Electroencephalographic Soc., Atlantic City, N. J., June 1962.

Also published in Electroencephalog. and Clin. Neurophysiol., v. 15: 305-320, Apr. 1963.

The effects of shaking on the electrical brain activity in cortical and subcortical structures were examined in 4 pig-tailed macaques. Shaking was performed over a continuous spectrum from 5-40 cps at a peak acceleration of 2 g over the greater part of the spectrum. Driving of brain rhythms at the shaking frequency, primarily 9-15 cps, was noted in the midbrain reticular formation, the nucleus centrum medianum, the visual cortex, and the hippocampal system. An essentially different distribution of driving was produced by photic stimulation.

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California U. [Brain Research Inst.] Los Angeles.

INFLUENCE OF SIMULATED ALTITUDE (18,000 FEET) ON FORMATION OF EXPERIMENTAL VESICAL CALCULI IN MALE RATS, by A. T. K. Cockett. [1962] [4]p. incl. illus. tables. (AFOSR-31453) (AF AFOSR-61-81) AD 427527 Unclassified

Also published in Jour. Urol., 89: 676-679, May 1963.

A method for the formation of vesical calculi in male rats at simulated altitudes is presented. Weight of bladder calculi formed experimentally in male rats at low barometric pressure without hypoxia (18,000 ft) is not significantly greater than calculi formed experimentally in rats at ground level. The significance of dehydration rather than altitude in flying personnel is mentioned. The possibility of urinary calculi as a result of extended space flight must await studies performed under altitude and prolonged weightless conditions. (Contractor's abstract)

435

California U. Brain Research Inst., Los Angeles.

APPLICATION OF PHASE DETECTION AND AVERAGING TECHNIQUES IN COMPUTER ANALYSIS OF EEG RECORDS IN THE CAT, by W. R. Adey and D. O. Walter. [1962] [24]p. incl. diagrs. refs. (AFOSR-64-1193) (Sponsored jointly by Air Force Office of Scientific

Research under AF AFOSR-61-81, National Aeronautics and Space Administration and Nadonal Institutes of Health) AD 442998 Unclassified

Also published in Exper. Neurol., v. 7: 186-209, Jan. 1963.

Consistency of phase patterns in EEG records from the hippocampal system and midbrain reticular formation have been examined in the course of behavioral training in 5 cats with implanted electrodes. These studies have involved novel application of computing techniques, including continuous measurement of phase and amplitude characteristics of single wave trains by digital filtering techniques, the use of cross-spectral analyses with calculation of complex transfer functions, and averaging of records during repeated behavioral performances with calculation of coherence functions in cross-spectral examinations. It was found that rhythmicity appeared in the computed average at the rate of the dominant EEG frequency as T-maze performance reached a high level, and was related to a reduction in scatter in phase patterns at high performance levels. Reversal of behavioral cues was associated with an immediate brief increase in rhythmicity of the average, then a decline followed by a progressive reemergence of rhythmicity at the end of retraining. Continuous phase-and-amplitude examinations during delayed response performance indicated a rhythmic phase modulation on wave trains with an apparently single frequency appearing during periods of discrimination. Comparison of probability bounds in cross-spectral analysis with use of a polar coordinate display have indicated major differences in phase relations between different hippocampal regions between correct responses in certain circumstances, with consistency in different examinations. These findings are discussed in relation to a stochastic model of the cerebral system, with reference to the possible role of the wave process in handling and storage of information.

436

California U. Brain Research Inst., Los Angeles.

HIPPOCAMPAL MECHANISMS IN PROCESSES OF MEMORY: THOUGHTS ON A MODEL OF CEREBRAL ORGANIZATION IN LEARNING, by W. R. Adey. [1962] [44]p. incl. diagrs. refs. (AFOSR-65-1502) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-81 and National Institutes of Health) AD 623060 Unclassified

Also published in Brain Function: RNA and Brain Function; Memory and Learning: Proc. Second Conf., Los Angeles, Calif., 1962, ed. by M. A. B. Brazier. Berkeley and Los Angeles, California U. Press, v. 2: 243-276, 1964. (AFOSR-65-1499)

A discussion is presented of the ablation and drug studies of the system organization of the hippocampus in animals. These studies support the idea that the hippocampal system is vitally concerned in the continued capability to make a discriminative performance involving the integrity of both recent and long-term memory functions. Computer analyses of various aspects of wave processes during discriminative learning indicated strong support of the hypothesis of conveyance of information on the basis of graded analog wave processes. Physicochemical changes in learning were directly monitored by application of impedance measuring techniques to the learning process. (Contractor's abstract)

437

California U. Brain Research Inst., Los Angeles.

DIFFERING EEG SLEEP STAGES AND THEIR RESPONSE TO TONE STIMULATION IN THE CHIMP, by J. M. Rhodes, W. R. Adey and others. [1962] [1]p. (AF AFOSR-61-81) Unclassified

Presented at Fall meeting of the Amer. Physiol. Soc., Buffalo U., N. Y., Aug. 28-31, 1962.

Published in The Physiologist, v. 5: 264, Aug. 1963.

By the use of stereotaxically implanted electrodes in subcortical areas of the brain and screw electrodes over the cortex. It has been possible to study the relationships between cortical and subcortical areas during 30 all-night sleep sessions with 3 chimpanzees. Clicks were presented at different stages of sleep and averaged evoked responses calculated. The general pattern of sleep stages is similar to that found in humans. In contrast to that found with lower animals, hippocampal leads failed to show reciprocal rhythms with the cortical leads. During "paradoxical" stages, 2 patterns were noted which could be differentiated primarily by the presence or absence of amygdaloid "spindling". The responses to clicks varied with the different stages and, though decreased, continued to be seen in the "paradoxical" stage. The results suggest: (1) the possibility of a higher level of sleep control for primates than previously thought, and (2) "paradoxical" sleep may have at least 2 types, one of which may involve internalization of attention rather than deep sleep.

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California U. Brain Research Inst., Los Angeles.

MUTUAL INFORMATION OF TWO PHYSIOLOGICAL RECORDS (Abstract), by D. O. Walter and D. Brown. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-81, National Aeronautics and Space Administration, and Public Health Service) Unclassified

Presented at Fall meeting of the Amer. Physiol. Soc., Buffalo U., N. Y., Aug. 28-31, 1962.

Published in The Physiologist, v. 6: 293, Nov. 1963.

The mutual information connecting 2 partially random functions is a general measure of interaction, and can be numerically estimated from physiological data. For two gaussian processes, i.e., those whose distribution of amplitudes follows the normal curve, the only relations possible are linear ones; here the cross-correlation function is sufficient to define the mutual information. Correlation, however, underestimates the mutual information for other distributions of amplitudes, or for such physiologically interesting relationships as

non-proportional response, or modulation of one signal by another. Lagged mutual information generalizes the cross-correlation function, and can be assembled into a cross-information function. Additional insight is provided by calculating the multivariate mutual information at several lags at once, these lags to be selected on the basis of the cross-information function. The degree of relationship indicated by cross-correlation vs that indicated by lagged and multivariate mutual information, between pairs of related electroencephalographic traces, will be compared, and the additional insight due to the new technique explained. The direct extension of such calculations to process additional parameters derived from EEG traces, such as filter outputs, will be shown to provide material for direct study of the cerebral coding of information transfer.

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California U. Dept. of Astronomy, Los Angeles.

A COMPARISON OF ASTRONOMICAL AND BALLISTIC TRADITIONS IN ORBIT COMPUTATION, by S. Herrick. May 1962, 25p. incl. refs. (Astrodynamical rept. no. 14) (AFOSR-2947) (AF 49(638)498) AD 277356
Unclassified

Presented at Internat'l. Union of Theoretical and Applied Mechanics, Internat'l. Symposium on the Dynamics of Satellites, Paris (France), May 28-30, 1962.

A mathematical study is presented of differential formulae, which are useful in the mathematical differential correction of an approximate orbit into better agreement with observation, in the physical or thrust differential correction of a non-rendezvous trajectory into one that intercepts its target, in guidance, in error analysis, and in optimization. The discussion is limited to a comparison of astronomical differential correction methods with the adjoint method that has come into space navigation from ballistics. (Contractor's abstract)

440

California U. Dept. of Chemistry, Los Angeles.

THE CRYSTAL STRUCTURE OF THE DIOLEFIN OF [2,2]PARACYCLOPHANE, by C. L. Coulter and K. N. Trueblood. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-65-2161) (AF 49(638)719) AD 627513
Unclassified

Also published in Acta Cryst., v. 16: 667-676, July 1963.

The diolefin of [2,2]paracyclophane ($C_{16}H_{12}$) forms monoclinic crystals with a_0 = 6.866, b_0 = 11.636, c_0 7.640A, β = 116.9°, and 2 molecules in the unit cell in space group $P2_1$ c. The structure has been refined by full matrix 3-dimensional least-squares methods, and the final parameters include small corrections for molecular libration. The aromatic rings are bent into a boat form about 14° at each end, and the bonds to the α-carbons are bent an additional 15° from the plane of the edge of each aromatic ring. The ring deformation may also be described as a folding of 16° about a line between the p-substituted atoms. The exocyclic single bond distance is 1.51A, at least 0.02A longer than normal. The lengthening is attributed in part to the orthogonality of the π-systems in the molecule and in part to intramolecular strain. Other distances are normal. The distribution of strain in the molecule is discussed.

441

California U. Dept. of Chemistry, Los Angeles.

THE CRYSTAL STRUCTURE OF TRIMETHYLOXOSULFONIUM PERCHLORATE $[(CH_3)_3SO]^+ClO_4^-$, by C. L. Coulter, P. K. Gantzel, and J. D. McCullough. [1962] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)719 and National Science Foundation)
Unclassified

Published in Acta Cryst., v. 16: 676-681, July 1963.

Crystals of $[(CH_3)_3SO]^+ClO_4^-$ display tetragonal symmetry with unit cell dimensions a = 11.66 ± 0.01A and c = 5.99 ± 0.01A. The space group is $P\bar{4}2_1m$ with Z = 4. A satisfactory trial structure was found by use of a 3-dimensional Patterson summation and the refinement was carried out by means of 3-dimensional difference syntheses and least-squares routine on the IBM 7090. The $[(CH_3)_3SO^+$ ion is required crystallographically to have the symmetry m but it approximates the symmetry 3m. The perchlorate ions are cyrstallographically of 2 types, one with required symmetry $\bar{4}$ and the other with required symmetry mm2. However, the perchlorate ions of the second type achieve the required symmetry in a statistical (disordered) manner. Bond distances and angles in the trimethyloxosulfonium ion are:

S-C(1) = 1.78 ± 0.01A, S-C(2) = 1.76 ± 0.01A, S-O = 1.45 ± 0.01A, C(1)-S-C(1) = 105.6 ± 0.7°, C(1)-S-C(2) = 105.7 ± 0.5°, C(1)-S-O = 112.1 ± 0.5°, C(2)-S-O = 114.8 ± 0.6°. In the ordered perchlorate ions: Cl-O = 1.45 ± 0.01A, O-Cl-O = 111.5 ± 0.9° and 108.8 ± 0.9°. (Contractor's abstract)

442

California U. Dept. of Chemistry, Los Angeles.

HIGH PRESSURE CHEMISTRY. I. ULTRA RAPID RATES AT VERY HIGH PRESSURES, by W. F. Libby. [1962] [6]p. incl. refs. (AFOSR-2923) (AF 49(638)991)
Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 1475-1480, Sept. 1962.

It appears to be true that strong shocks can cause chemical changes in solids at rates much higher than any known diffusion or nucleation growth mechanism can give. It is suggested that the extreme compressions caused by extreme pressures in the megabar region can convert

essentially the entire crystalline mass into a single activated complex which may be the often suggested metallic state all matter must give at extreme compression. Whether the transition state be metallic or not, the release of pressure following the passage of the shock wave causes the system to expand and thus to produce that form of ordinary matter which is stablest at the degree of expansion where the transition state ceases to be stable (in the case of the metallic manifestation, where it ceases to be metallic). Thus large masses of matter might be made to undergo certain special chemical changes at the incredible speeds corresponding to the duration of shock pressures. The special conditions are that compression of the original substance should give the same (metallic) transition state that compression of the product to the same density would have given and that the product be stabler at the conditions of compression, pressure, and temperature just following the passage of the shock wave and which first causes the (metallic) transition state to revert to an ordinary low pressure form. A particular case is thought to be the conversion of rhombohedral graphite to diamond by explosive shock. Another may be the formation of diamonds on impact in such meteorites as Canyon Diablo.

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California U. Dept. of Chemistry, Los Angeles.

CHEMISTRY OF POSITIVE IONS. II. ION-MOLECULE REACTIONS IN RADIOLYSIS OF N-HEXANE AT LOW TEMPERATURES, by L. Kevan and W. F. Libby. [1962] [2]p. incl. table. (AFOSR-J452) (Also bound with its AFOSR-4864; AD 414457) (AF 49(638)901)
Unclassified

Also published in Jour. Chem. Phys., v. 37: 2496-2497, Nov. 15, 1962.

Tabulated results of Co^{60} radiolysis of n-hexane at various temperatures are presented. Analyses were carried out by gas chromatography using a flame ionization detector. It was also found that the yield of n-dodecane at room temperature was not affected by 0.03 M added iodine or by 1% added pentene, both of which have been widely used as radical scavengers. In addition, 8 mol % propylamine did not reduce the yield. This strongly indicates that carbonium ions formed by loss of atomic hydrogen from the original parent-ion radicals formed by the radiation are not important. The carbonium ions would be strongly acidic. The scavenger results at room temperature indicate that n-dodecane is formed by an ionic process involving the original ion radicals. The increase in yield shows that this process becomes more efficient at low temperatures.

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California U. Dept. of Chemistry, Los Angeles.

ELECTRON TRANSFER AMONG THE TRANSITION ELEMENTS: THE CONTROLLING ROLE OF THE FRANCK-CONDON PRINCIPLE ON RATES, by W. F. Liffy. [1962] [16]p. incl. table, refs. (AFOSR-64-0027) (Also bound with its AFOSR-4864; AD 414457) (AF 49(638)901) AD 435953 Unclassified

Also published in Jour. Chem. Phys., v. 38: 420-425, Jan. 15, 1963.

The principle that electrons cannot be readily exchanged between aqueous ions of different valence, unless they possess sufficient geometrical similarity to reduce to a minimum the energy transfer required by the simultaneous and instantaneous conversion of an ion of one valence to another while a second is changed in the exact opposite way, has been firmly established. The Franck-Condon principle as applied to electron movement as well as to optical transitions thus has been found to be completely commanding in the case of electron exchange reactions transition element ions in aqueous solution, e.g., Fe^{2+} and Fe^{3+} exchange electrons slowly while $Fe(CN)_6^{4-}$ and $Fe(CN)_6^{3-}$ exchange very rapidly. Rapid electron exchange occurs also between MnO_4^{2-} and MnO_4^- even though the oxygen atoms do not exchange. Thus a type of tunneling of electrons is firmly proved to occur when the source and sink (reducing and oxidizing) ions (or molecules) satisfy the requirement of the Franck-Condon principle of being sufficiently similar geometrically to leave little need for change in hydration energy after the electron transfer. This principle should apply also to oxidation and reduction reactions among the transition elements, and the present work examines the available kinetic data (particularly those of Taube and co-workers) to establish the extent of this applicability which appears to be substantial.

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California U. [Dept. of Chemistry] Los Angeles.

THEORY OF METALLIC DIAMOND, by W. F. Libby. [1962] [5]p. (AFOSR-64-0030) (Also bound with its AFOSR-4864; AD 414457) (AF 49(638)901) AD 435951
Unclassified

Also published in Phys. Rev., v. 130: 548-549, April 15, 1963.

The fact that compression of Group IV elements and of Groups III-V and II-VI binary compounds forms new denser phases with 6 near neighbor body-centered tetragonal lattices which are metallic requires theoretical explanation. We think of this new set of metals as being typified by the expected new metallic phase of carbon to be obtained by compression of diamond which is called metallic diamond. It is proposed that this new class of metals of which tin is the only present example under ordinary conditions, and which may include a new metallic form of carbon denser than diamond called metallic diamond, can be understood as a 3-dimensional analog of the 2 dimensional metal graphite. The excess number of geometrically equivalent nearest neighbors over the 4 bonds possible from the available electrons and orbitals causes crystal-wide resonance which gives the metallic properties. (Contractor's abstract)

446

California U. Dept. of Engineering, Los Angeles.

A MODEL REFERENCED PARAMETER TRACKING TECHNIQUE FOR ADAPTIVE CONTROL SYSTEMS. I. THE PRINCIPLE OF ADAPTATION, by D. D. Donalson and C. T. Leondes. [1961] [12]p. incl. diagrs. (AFOSR-3116) (AF 49(638)438) AD 438554 Unclassified

Presented at Winter general meeting of the Amer. Inst. Elec. Engineers, New York, Jan. 28-Feb. 2, 1962.

Also published in IEEE Trans. on Appl. and Indus., v. 82: 241-252, Sept. 1963.

The purpose of this paper is to develop a fairly general approach to adaptive control systems which, at the same time, can be mechanized in a reasonable fashion. The development is carried out initially for a simple system with a linear time variant physical process and then extended to the general linear time variant case. Examples are given. (Contractor's abstract)

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California U. Dept. of Engineering, Los Angeles.

A MODEL REFERENCED PARAMETER TRACKING TECHNIQUE FOR ADAPTIVE CONTROL SYSTEMS. II. STABILITY ANALYSIS BY THE SECOND METHOD OF LYAPUNOV, by D. D. Donalson and C. T. Leondes. [1961] [19]p. incl. diagrs. (AFOSR-64-0972) (AF 49-(638)438) AD 440598 Unclassified

Presented at Winter general meeting of the Amer. Inst. Elec. Engineers, New York, Jan. 28-Feb. 2, 1962.

Also published in IEEE Trans. on Appl. and Indus., v. 82: 252-262, Sept. 1963.

The purpose of this paper is to develop stability analysis results for the type of adaptive control systems described in a companion paper. By their very nature such systems are in general nonautonomous since the inputs may be arbitrary functions of the time. The second method of Lyapunov supplies the principal tools for this stability analysis, while fairly general techniques are presented for generating the required Lyapunov functions for these systems. Although the analysis is carried out in detail for certain specific types of inputs, it is applicable to other types as well.

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California U. [Dept. of Engineering] Los Angeles.

THE USE OF THE TECHNIQUE OF LINEAR BOUNDS FOR APPLYING THE DIRECT METHOD OF LYAPUNOV TO A CLASS OF NONLINEAR AND TIME VARYING SYSTEMS, by R. A. Nesbit. [1962] [26]p. incl. diagrs. (Theory paper no. 420) (AFOSR-4218) (AF AFOSR-62-68) AD 292302 Unclassified

Presented at Second Internat'l. Cong. of the Internat'l. Fed. of Automatic Control, Basle (Switzerland) 1963.

Also published in Automatic and Remote Control, v. 2: 568-575, 1964.

The stability of a class of systems is shown by the use of the basic theorems of the direct method. This set of inequalities defines a region, and if the nonlinear or time varying part of the system remains inside this region, then the stability of the system is assured. The usual methods of approximating the time response may be used, and thus this technique can be used to aid the design of control systems. The technique is applied to second and third order examples and is compared to the 'variable gradient' method of solving these problems. (Contractor's abstract)

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California U. [Dept. of Engineering] Los Angeles.

THE PROBLEM OF OPTIMAL MODE SWITCHING, by R. A. Nesbit. Sept. 10, 1962, 19p. incl. diagrs. refs. (AFOSR-4219) (In cooperation with Aerospace Corp., El Segundo, Calif.) (AF AFOSR-62-68) AD 293152 Unclassified

Also published in Proc. Optimum System Synthesis Conf. Aeronautical Systems Division, Wright Patterson AFB, Sept. 11-13, 1962, p. 41-54.

A steepest descent modification of the switching times of a mode switching control system can be based on first variation computations, and the computer storage requirement less than that required for functional descent. By introducing control variables the mode switching system can be put in the format usually used in the study of control optimization. The application of the maximum principle yields a necessary condition for optimum switching and a necessary condition for chattering. If the switching problem is relaxed to assure the existence of an optimal solution, the computational problem of finding this optimum is not simplified by the switching approach although mechanization of the control system may be simplified. The use of steepest descent procedure for determining the suboptimal control, using a fixed number of switches, is only based upon differential arguments. Some knowledge of the global properties of the trajectory is required to assure the usefulness of the procedure. (Contractor's abstract)

450

California U. [Dept. of Engineering] Los Angeles.

SYNTHESIS OF OPTIMUM MULTIVARIABLE CONTROL SYSTEMS BY THE METHOD OF STEEPEST DESCENT, by H. C. Hsieh. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-J149) (AF AFOSR-62-68) AD 400377 Unclassified

Presented at Winter general meeting of the Inst. Elec. and Electron. Engineers, New York, Jan. 27-Feb. 1, 1963.

Also published in IEEE Trans. on Appl. and Indus., v. 82: 125-130, May 1963.

The optimum synthesis of multivariable control systems with generalized quadratic error criterion is solved by using the method of steepest descent in the Hilbert space. Apart from the conventional minimization techniques, this approach works directly on the functional of the error criterion itself so that the optimal solution can be determined through successive approximations. Since this solution can be obtained at high speed and with high accuracy by using a digital computer, this method is particularly useful in solving the actuation problem of adaptive control systems. (Contractor's abstract)

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California U. [Dept. of Engineering] Los Angeles.

THE PROBLEM OF OPTIMAL MODE SWITCHING, by R. A. Nesbit. [1962] [14]p. incl. diagrs. refs. (AFOSR-J775) (In cooperation with Aerospace Corp., El Segundo, Calif.) (AF AFOSR-62-66) AD 293152 Unclassified

Also published in Proc. Optimum System Synthesis Conf., Aeronautical Systems Division, Wright Patterson AFB, Sept. 11-13, 1962, p. 41-54.

For abstract see item no. 449, Vol. VI.

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California U. [Dept. of Engineering] Los Angeles.

A CONTROLLABILITY CRITERION FOR A CLASS OF LINEAR SYSTEMS, by A. R. Stubberud. [1962] [4]p. (AFOSR-J864) (AF AFOSR-62-68) AD 416557 Unclassified

Presented at Western Electronic Show and Convention, San Francisco, Calif., Aug. 20-23, 1963.

Also published in WESCON Technical Papers, v. 7 (Pt. 4): Paper no. 12.1, p. 1-4, 1963.

Also published in IEEE Trans. on Appl. and Indus., v. 83: 411-415, Nov. 1964.

A linear system is completely controllable if for any initial condition a control can be found to take the system to the origin. Present controllability criteria require knowing the weighting function matrix of the system. A criterion is presented which is applicable to a broad class of linear systems, and which does not require knowledge of this matrix. (Contractor's abstract)

453

California U. [Dept. of Engineering] Los Angeles.

REDUCIBILITY OF LINEAR SYSTEMS, by A. R. Stubberud. [1962] [6]p. (AFOSR-J1619) (AF AFOSR-62-68) AD 427713 Unclassified

Presented at Winter general meeting of the Inst. Elec. and Electron. Engineers, New York, Jan. 27-Feb. 1, 1963.

Also published in IEEE Trans. on Appl. and Indus., v. 82: 214-219, July 1963.

The concept of reducibility of linear differential equations is discussed. Reducibility is defined as the property which allows a differential equation to be reduced to an equivalent lower order differential equation. A criterion for reducibility and a technique for the reduction of linear differential equations are presented. A system for which this reduction is possible shall be called reducible and the property of being reducible shall be called reducibility.

454

California U. Dept. of Engineering, Los Angeles.

A SUBOPTIMAL ON-LINE DISCRETE CONTROLLER WITH BOUNDED CONTROL VARIABLES, by F. H. Kishi. [1962] [7]p. incl. diagrs. table. (AFOSR-65-0619) (AF AFOSR-62-68) AD 615182 Unclassified

Presented at IEEE Pacific annual meeting, Spokane, Wash., Aug. 26-29, 1963

Also published in IEEE Trans. on Appl. and Indus., v. 83: 216-222, July 1964.

A method to synthesize the control signal on-line, by using the form of an optimization problem is examined. Control of linear processes is considered, and bounds or inequality constraints on the control variable are attacked directly, without assigning penalties on the performance criterion. The optimal-control problem is formulated as a nonlinear programming problem, and the solution is obtained through a co-ordinate-wise gradient method. Simulation of the on-line controller is performed; a marked improvement in accuracy over conventional sampled data systems is shown. The method as presently employed, can consider bounds on the magnitude or on the ratio of change of the control variable. (Contractor's abstract)

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California U. [Dept. of Physics] Los Angeles.

A SIMPLE TREATMENT OF NUCLEAR DIRECT INTERACTION PROCESSES, by I. E. McCarthy and D. L. Pursey [1960] [4]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) Unclassified

Published in Proc. Internat'l. Conf. on Nuclear Structure, Kingston, Ontario (Canada) (Aug. 29-Sept. 3, 1960) Toronto U. Press, 1960, p. 381-384.

Physical arguments are used to predict the effect on differential cross-sections of various types of distortion of the wave-functions used in the distorted-wave Born approximation treatment of direct interactions. A simple but fairly realistic model for α-particle wave-functions gives reasonable agreement with observed cross-sections for (α,α') scattering.

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California U. [Dept. of Physics] Los Angeles.

BARYON MASS SPLITTING AND WEAK AND STRONG COUPLINGS, by K. Mahanthappa and W. Ramsay. [1962] [4]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)717] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 129: 2755-2758, Mar. 15, 1963.

The mass difference between various barvons is attributed to the presence of bosons weakly coupled to a primary baryon. As an example, the case of $\Sigma\Lambda$is treated assuming the Σ - Λ parity to be even. An eigenvalue condition derived by Albright, Blackenbecler, and Goldberger, using the N/D method is rederived in a simple manner. This derivation not only clarifies the assumptions, but makes the algebraic handling of the problem very simple. (Contractor's abstract)

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[California U. Dept. of Physics, Los Angeles.]

REACTION MATRIX THEORY FOR A FINITE NUCLEUS BY THE SEPARATION METHOD, by H. S. Köhler. [1962] [25]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)717] and National Science Foundation) Unclassified

Published in Nuclear Phys., v. 38: 661-685, Nov. 1962.

Binding energy, single particle energies and rad.as of oxygen-16 were calculated by the reaction matrix method. The single particle wave-functions were taken to be those of a harmonic oscillator. For the nucleon-nucleon potential, a hard core repulsion of radius 0.4 fm and an exponential shaped attraction with intrinsic range 2.5 fm and infinite scattering length were taken. This spin-independent potential was assumed to act only in s-states. The reaction matrix was calculated by the separation method. Saturation was obtained at an r.m.s. radius of 2.74 fm and a binding energy of 3.4 mev per nucleon. The experimental values are 2.58 fm and 8 mev per nucleon. The above potential will give too little binding also for infinite nuclear matter, at somewhat too small density. The characteristic features of the reaction matrix is discussed and an approximate but explicit expression given. It is brought out that the correlation between 2 nucleons depends mainly on the states or potential energies of the 2 nucleons and is larger of 2 nucleons deep down in the Fermi sea than at the top. It was concluded that this would lead to peculiar properties of nuclear matter. With the total energy given in the reaction matrix approximation the variational method gives a shell model potential consisting of essentially 3 parts. One corresponds to the ordinary Hartree-Fock potential. Another has closely the same form as the Hartree-Fock potential and decreases the strength of this by about 15% for infinite nuclear matter of normal density. The weakest part is proportional to the square of the local density and is at normal density $\approx$ -1 mev. The rearrangement energy for a nucleon at the top of the Fermi sea is thus obtained to be $\approx$ 8 mev. The single particle energies of oxygen-16 come out in fair agreement with experiments. The rearrangement energy, usually neglected when calculating the reaction matrix, gives a correction of $\approx$ -1 mev per nucleon in infinite nuclear matter and $\approx$ -0.1 mev per nucleon for oxygen-16.

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California U. [Dept. of Physics] Los Angeles.

SIMPLE TREATMENT OF PRODUCTION AMPLITUDES. I (Abstract), by C. Fronsdal, K. T. Mahanthappa, and R. E. Norton. [1962] [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., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 299-300, Apr. 23, 1962.

The Cini-Fubini approximate version of the Mandelstam representation can be easily derived directly, that is, without assuming the Mandelstam representation. This treatment has been extended to production amplitudes. The resulting representation may be viewed as an approximation to the as yet unknown complete representation for the production amplitudes. The method explicitly takes into account the 2-particle and 3-particle intermediate states; the higher particle number intermediate-state contributions are not entirely neglected When unitarity is imposed, soluble integral equations are obtained.

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California U. [Dept. of Physics] Los Angeles.

SIMPLE TREATMENT OF PRODUCTION AMPLITUDES. II (Abstract), by K. T. Mahanthappa, R. E. Norton, and C. Fronsdal. [1962] [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., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 300, Apr. 23, 1962.

The integral equations indicated in the foregoing abstract are reduced to the Fredholm form by the Omnes method, and the solutions are obtained under suitable approximations. Consistency of the solutions and applications to physical problems are discussed.

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California U. [Dept. of Physics] Los Angeles.

SIMPLIFIED TWO-DIMENSIONAL MODEL FOR NUCLEAR-COUPLING SCHEMES (Abstract), by S. A. Moszkowski. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-717], Army Research Office (Durham), and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 348, Apr. 23, 1962.

In order to gain insight into the relation of nuclear-coupling schemes to the basic 2 nucleon interactions, it may be instructive to consider a 2-dimensional analog of the nucleus. This model contains all the essential features of actual nuclei, such as saturation, shell structure, nuclear deformation, and pairing effects; it is much simpler to treat, although it lacks some detailed features of reality. The calculations become particularly simple in the case of short-range interactions with harmonic-oscillator wave functions. A basic interaction of the following form is assumed:

$$V = c_0\delta(r_{ij}) + c_1[p_{ij}^2\delta(r_{ij}) + \delta(r_{ij})p_{ij}^2] +$$

$$c_2 p_{ij}\delta(r_{ij})p_{ij} + c_3\delta(r_{ij})\delta(r_{ik})\delta(r_{jk}).$$

The 4 parameters are constrained by the requirement that the total nuclear energy is a minimum. The total energy turns out to be exactly 3/9 as large as for uniform matter of the mean-square radius as the oscillator distribution, regardless of the values of the parameters. Also, the energy lowering due to any quadrupole moment implies that the effective quadrupole-quadrupole interaction is very nearly of the strength required to give rotational spectra with $\mathcal{J} = \mathcal{J}_{rigid}$, where it not for pairing effects.

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California U. Dept. of Physics, Los Angeles

THE WEAK AND THE STRONG COUPLINGS AND GENERAL COVARIANCE, by R. Finkelstein and W. Ramsay. [1962] [26]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) Unclassified

Also published in Ann. Phys., v. 21: 406-433, Feb. 1963.

General covariance implies that the physical continuum is characterized by its connection, as well as by its local structure, and therefore by the symmetries of the connection, as well as of the local Lorentz and gauge groups. The connection of the local Lorentz group is as usual associated with the gravitational field; the corresponding connection of the gauge group is associated with the universal weak and electromagnetic couplings. The strong couplings have the complete symmetry of the local gauge group. The weak couplings have the lesser symmetry of the connection, which in turn corresponds to a subgroup of the local gauge group. There are 4 weak, charged vector bosons, associated in pairs with the right and left-handed connections of the gauge group; the only neutral vector is the photon. (Contractor's abstract)

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California U. Dept. of Physics, Riverside.

EXCHANGE NARROWING OF d BANDS IN FERROMAGNETS, by T. Wolfram and J. Callaway. [1962] [7]p. incl. refs. (APOSR-4069) (AF AFOSR-61-70) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 219, Mar. 26, 1962.

Also published in Phys. Rev., v. 127: 1605-1611, Sept. 1, 1962.

A semiphenomenological Hamiltonian based on the generalized Hartree-Fock equations for a 2-component spinor is developed which describes the interaction of an electron in the d band with the spin waves of a ferromagnet. Solutions to the effective Hamiltonian are examined in the tight-binding approximation using a self-consistent separation of the electron and spin wave variables. The dynamic interaction of the electron with the spin waves gives rise to a band-narrowing factor $\exp(-\zeta)$ analogous to that obtained by Yamashita and Kurosawa for the polaron. ζ increases with temperature and estimates show that it may be on the order of unity for a typical ferromagnet at low temperatures.

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California U. Dept. of Physics. Riverside.

MOMENT SINGULARITY EXPANSION FOR THE DENSITY OF STATES, by J. Callaway and A. J. Hughes. [1962] [5]p. incl. diagrs. tables, refs. (AFOSR-J35) (AF AFOSR-61-70) AD 297117 Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 219, Mar. 26, 1962.

Also published in Phys. Rev., v. 128: 134-138, Oct. 1, 1962.

A systematic approximation procedure is developed to determine the density of states associated with a particular energy band. The density of states is expressed as the sum of 2 functions, 1 of which contains the discontinuous derivatives produced by critical points, and is determined once the effective masses at these points are known; the other is smooth, and is expanded in Jacobi polynomials. The coefficients in this expansion are determined from the moments of the distribution. Two applications of the method are given.

464

California U. Dept. of Physics, Riverside.

SPIN-WAVE CONTRIBUTION TO THE SPECIFIC HEAT OF EuS, by D. C. McCollum, Jr. and J. Callaway. [1962] [2]p. incl. diagrs. (AFOSR-J52) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-70 and National Science Foundation) AD 400390 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 376-377, Nov. 1, 1962.

Ferromagnetism has recently been reported in EuS and in other insulating europium salts. EuS has the NaCl structure, the europium ion being in an S state with $S = 7/2$. The nature of the ferromagnetic exchange coupling has not been clear since direct exchange through overlap of the 4f electron wave functions is unlikely to be important. A possible indirect exchange coupling mechanism has been proposed. Specific heat measurements on EuS were undertaken in order that the results might be compared with the predictions of spinwave theory.

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California U. Dept. of Physics, Riverside.

DIRECT MEASUREMENT OF THE ENERGY OF ELECTRONS OBTAINED FROM THE SURFACE OF SILICON BY FIELD EMISSION, by A. M. Russell. [1962] [2]p. incl. diagrs. [AF AFOSR-61-70] Unclassified

Published in Phys. Rev. Ltrs., v. 9: 417-418, Nov. 15, 1962.

Field emission of electrons from a silicon point is discussed. In particular, measurements of the critical bias applied to the collecting electrode as a function of applied voltage are considered at room temperature. It is concluded that the additional negative bias required at high fields is caused by an increase in the potential difference across the silicon emitter.

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California U. [Dept. of Physics] Riverside.

PSEUDOPOTENTIAL FOR SODIUM (Abstract), by A. J. Hughes. [1962] [1]p. [AF AFOSR-61-70] Unclassified

Presented at meeting of the Amer. Phys. Soc., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 611, Dec. 27, 1962.

The potential energy of a valence electron in sodium is represented by the function $V(r) = -2/r + Qe^{-Br}/r$. The second term is repulsive and includes the effects of orthogonality of the valence electron to the core electrons. The following method was used to determine the parameters Q and B. The 3s and 3p radial equations were integrated numerically with trial values of Q and B out to a radius in the Coulombic region. The logarithmic derivatives were then calculated and compared to those required by the Coulomb wave equation for the experimental eigenvalues. The Coulomb logarithmic derivatives were computed from a semiconvergent expansion in decreasing powers of r and valid at large r. The parameters were then varied until agreement between logarithmic derivatives was obtained. The final values for Q and B were found to be 20.915 and 2.0644, respectively. Using these values for the potential, the eigenvalues for the 4s, 4p and 5s, 5p states were determined and found to agree with experimental values to within 1.5%.

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California U. [Dept. of Physics] Riverside.

SPIN WAVE THERMAL CONDUCTIVITY (Abstract), by J. Callaway and T. Wolfram. [1962] [1]p. [AF AFOSR-61-70] Unclassified

Presented at meeting of the Amer. Phys. Soc., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 619, Dec. 27, 1962.

In insulating ferromagnets and in garnets, thermal conduction at low temperatures may proceed primarily through spin waves. The thermal conductivity due to spin waves has been calculated under the assumption that the waves are scattered by boundaries and by point imperfections and compared with the conductivity due to phonons. The mean free path for the scattering of spin waves by point defects has been calculated and found to be proportional to k^{-4} for long wavelengths. The conductivity is proportional to T^2 at the lowest temperatures where boundary scattering is dominant, with corrections of order T^3 and T^4 resulting from dispersion and defect scattering.

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California U. [Dept. of Physics] Riverside.

ULTRAVIOLET ABSORPTION BANDS IN COLD-WORKED KCl (Abstract), by R. W. Wild and A. N. Jette. [1962] [1]p. [AF AFOSR-61-70] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 178, Mar. 26, 1962.

A series of uv absorption bands has been observed in single crystals of Harshaw KCl at low temperature. Some of these bands occur at the same wave lengths as those reported by Lüty for additively colored KCl. The intensity of the observed bands in the additively

colored crystals was proportional to the F-center concentration; the authors observed them in the virgin Harshaw crystals where no measurable F concentration was found. The fact that the intensity appears to depend on the degree of cold work and a diffusion time lead the authors to interpret this as a low-temperature collector of point defects along dislocation lines. These centers have been observed to be stable in the temperature range from 78° to 193°K but disappear at higher temperatures.

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California U. Dept. of Physics, Riverside.

SPIN WAVE-ELECTRON INTERACTIONS IN MAGNETIC SOLIDS, by T. Wolfram Doctoral thesis, Aug. 1962, 146p. incl. diagrs. refs. (AFOSR-4073) (AF AFOSR-61-70 and AF AFOSR-62-318) AD 291499 Unclassified

The formal theory of spin waves in ferro- and antiferromagnetic insulators is reviewed. Some recent experiments which have established the existence of the spin wave and its associated quantum of energy, the magnon, are discussed. Slater's band theory of spin waves in insulators and its generalization by Edwards to ferromagnetic metals is considered. The band-type states interact dynamically with the spin wave states. A semiphenomenological theory describing the interaction of electrons and spin waves is formulated. The intraatomic exchange arising in the Hartree-Fock equations is treated as an operator which couples the 'itinerant' electron to the spin wave system. The coupled Hamiltonian is then separated into effective electron and spin wave Hamiltonians. The average effect of the spin waves on the electron in both the ferro and antiferromagnet is shown to result in a dynamic interaction which gives rise to a localization of the electron and a narrowing of the d-band width. The electronic band width depends parametrically upon the state of excitation of the spin system, and decreases with temperature. In the ferromagnet this interaction can cause an asymmetry in the density of states: the density of states for the spin 'down' sub-band being larger than that of spin 'up' sub-band. (Contractor's abstract)

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California U. Dept. of Physics, Riverside.

INDIRECT EXCHANGE FERROMAGNETISM IN INSULATORS, by J. Callaway. [1962] [3]p. (AFOSR-J259) (AF AFOSR-62-318) AD 400885 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 625-627, Nov. 1, 1962.

The discovery of insultating ferromagnetism including EuO, EuH2. and EuS (1-3) has raised questions concerning the nature of the exchange interaction responsible for the alignment of 4f electron spins. Direct exchange between 4f electons on differing lattice sites is not likely to be important, nor is the standard energy band theory of ferromagnetism applicable. An indirect coupling mechanism which may be responsible for ferromagnetism in these materials is described qualitatively.

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California U. Dept. of Physics, Riverside.

METAL TO INSULATOR TRANSITION IN ANTIFERROMAGNETS, by J. Callaway. [1962] [6]p. incl. diagrs. (AFOSR-J563) [AF AFOSR-62-318] AD 412691 Unclassified

Also published in Internat'l. Conf. on the Physics of Semiconductors, Exeter (Gt. Brit.) (July 1962), London Inst. of Physics and the Physical Society, 1962, p. 584-589.

The energy band theory of anti-ferromagnetism, originally proposed by Slater, has been applied to a study of the transition between metallic and insulating states of an anti-ferromagnet. A 2-sub-lattice model of an anti-ferromagnet with body-centered cubic crystal structure was considered. An electron in this model experiences a periodic array of exchange potentials.

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California U. Dept. of Physics, Riverside.

EXCHANGE NARROWING OF d BANDS IN ANTIFERROMAGNETS, by T. Wolfram and J. Callaway. [1962] [5]p. (AFOSR-J707) (AF AFOSR-62-318) AD 413649 Unclassified

Also published in Phys. Rev., v. 130: 45-49, Apr. 1, 1963.

The theory of exchange narrowing of d bands presented in a previous paper for the ferromagnet is extended to the case of the antiferromagnet It is shown that the dynamic spin wave-electron interaction gives rise to a narrowing factor $e^{-\zeta}$. ζ depends upon the state of excitation of the spin system and increases with the number of antiferromagnetic magnons and hence with temperature It is suggested that this effect may contribute to the high resistivity of a large number of antiferromagnetic compounds.

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California U. [Dept. of Physics] Riverside.

FERROMAGNETIC TRANSITION IN EuS (Abstract), by R. L. Wild and R. D. Archer. [1962] [1]p. [AF AFOSR-62-318] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 440, Aug. 27, 1962.

EuS is found to undergo a ferromagnetic transition at a Curie temperature of 20°K. It was indicated that this is the first rare-earth sulfide to show ferromagnetic behavior. The possibility of this ferromagnetic state was suggested by J. Callaway. The sample was prepared

by passing purified hydrogen-sulfide gas over 99.8% pure Eu_2O_3 held at a temperature of 1100°C. The excess sulfur was removed by heating in a vacuum. A pellet was pressed at 10,000 atm and made into a Rowland ring which served as the core of a transformer. The sample was found to have NaCl-type structure by x-ray diffraction. Measurement of the thermal conductivity, magnetic susceptibility, and specific heats as a function of temperature are planned.

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Cambridge Language Research Unit (Gt. Brit.).

RESEARCH ON INFORMATION STRUCTURE, by E. W. Bastin. Annual rept. no. 2, Jan. 1-Dec. 31, 1961. Mar. 12, 1962 [25]p. incl. diagrs. refs. (AFOSR-2533) (AF 61(052)331) AD 289450 Unclassified

It is shown how the PACE analogue representation of an information structure can be used to calculate numbers that are of the right sort to interpret as elementary particle constants. This method of calculation is related to that employed by Heisenberg using a non-linear wave equation. The first part of the report describes how an important case of the application and use of an information structure is to be found in the analysis of the origin and nature of the fundamental constants of elementary particle physics. The second part relates the process of calculation of such constants from the properties of an information structure to the non-linear wave equation technique being used by Heisenberg.

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Cambridge Language Research Unit (Gt. Brit.).

A THEORY OF THE ORIGIN OF MASS WITHIN A CONTROL MODEL OF THE ELEMENTARY PARTICLES, by E. W. Bastin and A. Woodside. Feb. 20, 1962 [12]p. incl. diagrs. (AFOSR-2702) (Also bound with its AFOSR-2533; AD 289450) (AF 61(052)331) AD 275843 Unclassified

A new method is shown for calculating elementary particle constants because the current method is appropriate only when some constants, which will be called primary constants, are assumed to be known already. The experimental computing method for deriving numbers which have the right logical form to be interpreted as the primary type of constant characteristic of elementary particles is described. A summary of the theoretical status of the results obtained is presented. The theoretical step that still has to be taken is that of defining combinations of systems, which will be done by developing the interpretation of the described model to include the idea of partitioning the sets of elements in a single level to provide quasi-independent sub-systems. This concept of a physically measurable quantity is extended from the field of natural numbers to the field of rationals.

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Cambridge Language Research Unit (Gt. Brit.).

THE CALCULATION OF CONSTANTS OF THE STABLE PARTICLES, by E. W. Bastin and A. F. Parker-Rhodes. 1962, 21p. incl. diagrs. (Rept. no. ISU 8) (AFOSR-5050) (AF 61(052)331) AD 414082 Unclassified

The algebra of Descriptive Heirarchy is used to deduce the basic dimensionless ratios relating to the stable elementary particle system (the proton/electron system). To carry out these deductions, a control system (a basis for a general picture of the physical world) is introduced based on the ordinary idea of a constant of nature. From this it is eventually shown that there must exist quantities which underlie measurement but are not themselves particular values of a potentially continuous variate. The fact that there exists universal units (e.g. of charge or spin) forces a distinction between the classical constants of nature and protarithms to be made.

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[Cambridge Language Research Unit (Gt. Brit.)]

PRESENTATION OF THE HEISENBERG REQUIREMENT OF NON-DECOMPOSABILITY IN PARTICLE THEORY BY USE OF OVERALL FEEDBACK IN A CONTROL SYSTEM, INSTEAD OF BY THE USE OF NON-LINEARITY IN DIFFERENTIAL EQUATIONS, by E. W. Bastin and C. W. Kilmister. [1962] [8]p. incl. diagr. (Bound with its AFOSR-2533; AD 289450) [AF 61(052)-331] Unclassified

A discussion is presented of the relationship between the CASPAR method of calculating constants characteristic of elementary particles and current quantum mechanical methods. The approach used here is distinct from quantum field theory (Heisenberg's non-linear theory) in that if particle constants are to be calculated then the calculation must depend in an essential way upon the existence of interactions between the modes of representation of the particles. The CASPAR theory is based upon the idea of a control system and the types of mathematical deduction that are admitted within it have themselves ultimately to be built up from this idea. It will be apparent that there is a basic formal difference between the theory that is being described and quantum mechanics. For if one describes the control system in terms of a differential equation, then this equation will be in one independent variable whereas the wave equation of quantum mechanics is a partial differential equation in 4 independent variables. The various arguments given in this article are the basis for the use of control systems which are being used in designing the next PACE experiment. If the forthcoming experiment is successful it will then be possible to initiate discussion with the Heisenberg school on the further potentialities of the control technique.

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Cambridge Language Research Unit (Gt. Brit.).

FREEING THE MIND. VI. THE INTELLECTS NEW

EYE, by M. Masterman. [1962] [1]p. (AFOSR-J546) (AF 61(052)542) AD 411446 Unclassified

Also published in Times Literary Suppl., v. 61: 284, Apr. 27, 1962.

It is suggested that the use of the digital computer to process non-numerical data can stimulate new theoretical concepts, intitutive as well as mathematical. Examples are cited from experiments involving word games, machine translations and classificatory problems. Despite its application to linguistics, medicine, and anthropology, the potential range of application and development of this new theory has only been scratched.

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Cambridge U. Cavendish Lab. (Gt. Brit.).

THE DEPENDENCE OF CROSS-SLIP ON STACKING-FAULT ENERGY IN FACE-CENTERED CUBIC METALS AND ALLOYS, by P. R. Thornton, T. E. Mitchell, and P. B. Hirsch. Annual summary rept. no. 3, July 9, 1962. 17p. incl. diagrs. tables, refs. (AFOSR-2934) (AF 61(052)98) AD 289147 Unclassified

Also published in Philos. Mag., v. 7: 1349-1369, Aug. 1962.

The results of an experimental study of the temperature and strain-rate dependence of τ_{III} for Cu-Zn alloys are described and interpreted in terms of Seeger's theoretical analysis of τ_{III}. The values of the stacking-fault energy, γ, derived in this way are compared with the estimates of γ for the same alloys obtained directly from electron microscope observations of dislocation nodes. The two sets of values are found to disagree, and the nature of the discrepancy is such as to throw serious doubts on the applicability of the Seeger analysis to Cu-based alloys with $e/a > 1{\cdot}10$. The lower limits of γ for pure Cu and Ag, from electron microscope data, are ~ 60 ergs/cm^2 and ~ 20 ergs/cm^2; the values of γ deduced from Seeger's τ_{III} analysis are ~ 170 ergs/cm^2 and ~ 30 ergs/cm^2, respectively. The lower limit of γ for Cu is inconsistent with the previously accepted figure based on the assumption that γ is twice the twin boundary energy, and this assumption is now held to be invalid. Seeger's model of cross-slip at Lomer-Cottrell barriers is examined critically, and found to be incompatible with the observations in Cu and Al that screws are held up preferentially. It is proposed that screws are stopped by becoming heavily jogged in the dense tangles observed by transmission microscopy, and that cross-slip occurs at these tangles by processes controlled by jogs. (Contractor's abstract)

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Cambridge U. Cavendish Lab. (Gt. Brit.).

THE ALUMINUM-RHENIUM AND ALUMINUM-TECHNETIUM SYSTEMS: THE NEW PHASES $ReAl_6$ AND $TcAl_6$, by L. M. D'Alte Da Veiga. [1962] [2]p. (AFOSR-3817) (AF EOAR-61-24) Unclassified

Also published in Philos. Mag., v. 7: 1247-1248, July 1962.

Two previously unreported phases, $ReAl_6$ and $TcAl_6$, were found and appear to be isostructural with $MnAl_6$. Powder photographs of the 3 systems are similar and the systematic absences for $ReAl_6$ and $TcAl_6$ are consistent with the space group Cemm previously proposed for $MnAl_6$. The crystals are prismatic needles of the form (110) and cell dimensions are a = 6.59, b = 7.61, and c = 9.02A for $ReAl_6$; and a = 6.58, b = 7.63, and c = 9.00A for $TcAl_6$.

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Cambridge U. Cavendish Lab. (Gt. Brit.).

THE ELECTRON DISTRIBUTION IN CHROMIUM, by M. J. Cooper. [1962] [6]p. incl. tables, refs. (AFOSR-J43) (AF EOAR-61-24) AD 297113 Unclassified

Also published in Philos. Mag., v. 7: 2059-2064, Dec. 1962.

X-ray intensity measurements for Cr powder, AgKα radiation, were placed on an absolute scale by direct measurement of the power in the incident beam. Effects due to preferred orientation, surface roughness and extinction were shown to be negligible and measurements using CuKα radiation confirmed the absence of effects which vary with wavelength. The experimental scattering factors determined from the intensity measurements were found to agree with the theoretical values for the ground-state free atom on a relative scale, but to be about 5% lower on an absolute scale. This is similar to the 4% difference reported by Batterman, Chipman and DeMarco for measurements on Fe, Cu and Al, and comparison of measurements from a sample of this Cu with those from Cr confirmed the agreement of the absolute scales. (Contractor's abstract)

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Cambridge U. Cavendish Lab. (Gt. Brit.).

THE STRUCTURE OF THE σ-PHASE Co_2Mo_3, by J. B. Forsyth and L. M. D'Alte Da Veiga. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-J741) (AF EOAR-61-24) AD 413642 Unclassified

Also published in Acta Cryst., v. 16: 509-512, June 10, 1963.

The σ-phase structure of Co_2Mo_3 has been confirmed by single-crystal measurements. The structure has been refined and the interatomic distances compared with those in Co_7Mo_6 and 3 other σ-phases. The distribution of atoms in the available sites has been determined:

cobalt occupies the 12-fold, molybdenum the 15-fold, and a mixture of Co and Mo the 14-fold coordinated positions. (Contractor's abstract)

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Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

ANOMALOUS SINGULARITIES IN PHYSICAL REGIONS, by P. V. Landshoff. [1962] [2]p. (AFOSR-J221) (AF EOAR-63-79) AD 400440 Unclassified

Also published in Phys. Ltrs., v. 3: 116-117, Dec. 15, 1962.

An explicit example is given of a singularity for a production process, using perturbation theory. It is argued, however, that these singularities cannot occur in scattering processes.

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Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

FINAL-STATE INTERACTIONS IN THE ELECTRO-DISINTEGRATION OF DEUTERIUM, by J. Nuttall and M. L. Whippman. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0369) (AF EOAR-63-79) AD 434524 Unclassified

Also published in Phys. Rev., v. 130: 2495-2501, June 15, 1963.

The cross-section for the inelastic-deuteron scattering process is calculated using a semirelativistic approximation. The final-state interaction between the outgoing nucleons is estimated using approximate wave functions derived from the Gammel-Thaler potential. The rescattering correction is found to lead to a decrease in the peak value of the cross section, varying from about -5% at an electron momentum transfer of $1.4F^{-1}$ to about -2% at a momentum transfer of $4F^{-1}$. Various relativistic corrections are considered, and an ambiguity in the normalization of the semirelativistic wave functions is discussed. Finally, the neutron form factors are re determined.

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Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

ON THE ANALYTIC CONTINUATION OF THE SCATTERING AMPLITUDE THROUGH A THREE-PARTICLE CUT, by D. I. Olive [1962] [19]p. incl. diagrs. refs. (AFOSR-64-0378) (AF EOAR-63-79) AD 434535 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 1318-1336, June 16, 1963.

The scattering amplitude is analyzed onto the sheet reached by encircling the lowest 3-particle singularity in an anticlockwise direction by using generalized normal threshold discontinuity formulae derived from unitarity. The integral equation is not Fredholm because of the connectedness structure of the 3-particle amplitude but this difficulty is overcome by a manipulation which introduces extra integrations in which complex normal thresholds may occur. If there is a 2-particle state 2' with a particle in common with the 3-particle state, then the normal threshold corresponding to the state 2', which vanishes on this particular 3-particle sheet, is verified. Three-particle sheets reached by different routes are also considered.

486

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

UNITARITY AND THE EVALUATION OF DISCONTINUITIES. II, by D. I. Olive. [1962] [10]p. incl. refs. (AFOSR-64-0379) (AF EOAR-63-79) AD 434534 Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 326-335, July 16, 1963.

The discontinuity across the cut due to the normal threshold N in the scattering amplitude is found to be a modification of the term in unitarity involving the state N. The result shows that it is easiest to continue onto the unphysical sheet reached by encircling the normal threshold in an anticlockwise direction and enables unitarity to be replaced by a system of simpler equations. The result is understood in perturbation theory and is presented in terms of a specially introduced path notation for unphysical sheets. Although the argument is mainly restricted to 2-particle thresholds, it permits the analytic continuation round the lowest 3-particle cut. The difficulties in extending the analysis to multiparticle processes are reviewed. (Contractor's abstract)

487

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

HIGH-ENERGY BEHAVIOR IN PERTURBATION THEORY, by J. C. Polkinghorne. [1962] [4]p. incl. diagrs. (AFOSR-64-0528) (AF EOAR-63-79) AD 436360 Unclassified

Also published in Jour. Math. Phys., v. 4: 503-506, Apr. 1963.

The dominant-high energy behavior of a wide class of Feynman diagrams is investigated. When the leading contributions are summed, they are shown to give a behavior consistent with the Regge-pole hypothesis. Series expansions for the trajectory and residue of the dominant Regge pole are obtained in this approximation. (Contractor's abstract)

488

Cambridge U. Dept. of Zoology (Gt Brit.).

STUDY OF THE DEVELOPMENT AND INTEGRATION OF NEST-BUILDING SKILLS IN CANARIES. THE EFFECT OF ABLATION OF THE FOREBRAIN ON AVIAN BEHAVIOUR. CURIOSITY AND FEAR RESPONSES TO STRANGE STIMULI, by R. A. Hinde. [Final rept.] 1962 [7]p. incl. refs. (AFOSR-2504) (AF 61(052)97) AD 280104 Unclassified

The development and integration of nest-building skills in canaries was studied by manipulation of environmental stimuli and control of the hormonal state. Special attention was given to the short-term and long-term aspects of interaction between environmental and internal factors. The effects of forebrain ablations on discrimination learning and general activity in pigeons and on the reproductive development of canaries were studied. The nature of approach-avoidance conflict is now being studied.

489

Cambridge U. [Dept. of Zoology] (Gt. Brit.).

ROLES OF THE MALE AND THE NEST-CUP IN CONTROLLING THE REPRODUCTION OF FEMALE CANARIES, by R. P. Warren and R. A. Hinde. [1961] [4]p. incl. diagr. refs. [AF 61(052)97] Unclassified

Published in Animal Behav., v. 9: 64-67, Jan.-Apr. 1961.

The influence of the male and of nesting facilities on the progress of the reproductive cycle of female canaries in spring was assessed. Stimuli from the male may influence the start of defeatherization and certainly influence the occurrence of nest-building in the female. Stimuli from the nest influence defeatherization and egg-laying.

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Cambridge U. [Dept. of Zoology] (Gt. Brit.).

TEMPORAL RELATIONS OF BROOD PATCH DEVELOPMENT IN DEOMESTICATED CANARIES, by R. A. Hinde. [1961] [9]p. incl. illus. diagrs. refs. (AF 61(052)97) AD 632081 Unclassified

Published in Ibis, v. 104: 90-97, Jan. 1962.

An attempt has been made to trace the temporal course of brood patch development in some detail, and to assess its relationship with the changes in reproductive behavior which occur as the breeding cycle progresses. The temporal relations between the loss of feathers, vascularization, nest-building, egg-laying and incubation indicate the extent to which these different aspects of reproductive development share causal factors. In order that such temporal correlations should be meaningful, it was necessary that they should be based on birds showing a reasonable variability in their reproductive cycles. This was ensured by providing sub-optimal breeding conditions: if canaries are not allowed to build nests, many of the females undergo a protracted reproductive development, and many of the clutches laid are not incubated. (Contractor's abstract)

491

Cambridge U. Psychological Lab. (Gt. Brit.).

EFFECTS OF FRONTAL CORTEX LESIONS ON OBJECT DISCRIMINATION LEARNING BY MONKEYS, by J. Oxbury and L. Weiskrantz. [1962] [2]p. incl. diagrs. table (AFOSR-3321) (AF 61(052)185) AD 632629 Unclassified

Also published in Nature, v. 195: 310-311, July 21, 1962.

The domination of stimulus preference factors in the performances of monkeys with frontal lesions was tested in a modified version of the Wisconsin general testing apparatus. The test was designed specifically to provide data in a form amenable to mathematical analysis of the frequency with which various strategies were adopted. There appears to be a discrepancy between the results presented here and previous data which indicated that frontal monkeys are impaired on object discrimination problems. Reasons argued in explanation include a recently proposed hypothesis that frontal lesions may result in an inability to maintain selective attention.

492

Cambridge U. Psychological Lab. (Gt. Brit.).

VISUAL FIELD DEFECTS IN MONKEYS, by A. Cowey. [1962] [1]p. (AFOSR-3522) (AF 61(052)185) Unclassified

Also published in Nature, v. 193: 302, Jan. 20, 1962.

The visual fields of rhesus monkeys have been studied perimetrically before and after removal of parts of the striate cortex. Four rhesus monkeys were tested several months; 3 had the macular projection area removed bilaterally and the 4th an entire occipital lobe removed. Visual field defects of expected size, shapes and position were produced but the animal's ability to respond to a flash of light was not abolished. It is concluded that up to half the striate cortex may be removed in the monkey without producing a region of total blindness in the visual field. The monkey may therefore be very different from man in this respect; the explanation for the residual vision is far from clear. Further electrophysiological and behavioral experiments are in progress in an effort to resolve this problem.

493

Cambridge U. Psychological Lab. (Gt. Brit.).

EFFECTS OF STIMULATION ON FRONTAL CORTEX AND HIPPOCAMPUS ON BEHAVIOUR IN THE MONKEY, by L. Weiskrantz, Lj. Mihailović, and C. G. Gross

[1962] [19]p. incl. illus. diagrs. refs. (AFOSR-4180) (AF 61(052)185) AD 632630 Unclassified

Also published in Brain, v. 85: 487-504, 1962.

The effects of stimulation of various regions at intensities below the threshold for overt motor responses, was studied on a variety of behavioral tasks, with the following results: (1) A reversible deficit in delayed alternation was obtained by bilateral stimulation in the region of sulcus principalis. During stimulation, performance approached chance levels; (2) Unilateral stimulation in the region of sulcus principalis produced a significant and reversible deficit in delayed alternation, although the decrement was not as greast as that produced by bilateral stimulation; (3) No such deficit was obtained from stimulation of regions near sulcus arcuatus; (4) No effect of frontal stimulation on auditory discrimination performance could be found; (5) Hippocampal stimulation had a slight effect on both delayed alternation and auditory discrimination; and (6) Unilateral or bilateral stimulation near sulcus principalis produced a decrement in the speed with which object discrimination tasks were solved. No such decrement was obtained for the more difficult 2-dimensional pattern discrimination problems. (Contractor's abstract)

494

Cambridge U. Psychological Lab. (Gt. Brit.).

EVIDENCE FOR DISSOCIATION OF IMPAIRMENT ON AUDITORY DISCRIMINATION AND DELAYED RESPONSE FOLLOWING LATERAL FRONTAL LESIONS IN MONKEYS, by C. G. Cross and L. Weiskrantz. 1962. [24]p. incl. diagrs. tables, refs. (AF 61(052)-185 AD 632631 Unclassified

Published in Exper. Neurol., v. 5: 453-476, June 1962.

Impairments on both delayed-response and auditory-discrimination tasks have been reported to follow lateral frontal cortical lesions in monkeys. The present study is primarily concerned with the relationship of these 2 deficits. Three monkeys received ablations of sulcus principalis: 3 received ablations of lateral frontal cortex excluding sulcus principalis. Acquisition and retention of auditory-discrimination, delayed-response, and visual-discrimination tasks by the 2 groups were compared. Sulcus principalis lesions produced greater impairment on the delayed-response tasks. The lesions sparing sulcus principalis produced greater impairment on the auditory-discrimination tasks. The performance of the groups did not differ on the visual-discrimination tasks. These results suggest that the delayed-response deficit and the deficit in auditory discrimination that follow large frontal lesions may be dissociated by smaller frontal lesions. The results confirm that the focus for impairment on tests of the delayed-response type is in the region of sulcus principalis. The experimental data do not indicate the focus (if any) for the auditory-discrimination deficit, nor do they permit the definition of the nature of this deficit. (Contractor's abstract)

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Cambridge U. Psychological Lab. (Gt. Brit.).

VISUAL ILLUSIONS IN SPACE, by R. Gregory. [1962] [4]p. incl. illus. diagrs. (AFOSR-J59) [AF EOAR-61-13] AD 400095 Unclassified

Also published in New Scientist, v. 15: 446-449, Aug. 30, 1962.

Some of the environmental conditions expected in space are simulated in the laboratory to test their effect on the visual perception of man. Investigations are conducted on perceptually reversed lattice figures during movement, object ambiguity, effects of oblique lighting, and reversals in depth. Results suggest that manned space operations will be subject to inconvenience and error arising from visual illusions. With all its limitations, the perceptual system of man appears to be far more efficient at identifying objects against a confused background than any instruments yet developed.

496

Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt. Brit.).

UNIT ACTIVITY IN THE HYPOTHALAMUS AND THE SYMPATHETIC RESPONSE TO HYPOXIA AND HYPERCAPNIA, by B. A. Cross and I. A. Silver. [1962] [19]p. incl. illus. refs. (AFOSR-J839) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)301 and Public Health Service) AD 416515 Unclassified

Also published in: Exper. Neurol., v. 7: 373-383, May 1963

The activity of 232 neurons in the hypothalamus and other forebrain regions was recorded with stereotaxically oriented steel microelectrodes in rabbits under light urethane anesthesia. Inhalation of N_2 or N_2O for 10 to 30 sec reduced brain oxygen tension by 30 to 90% and accelerated the firing rate of 27% of neurons tested. Slowing to hypoxia occurred in 36%. Inhalation of 80% CO_2 and 20% O_2 for 5 to 15 sec elevated brain oxygen tension and 99% of the neurons tested gave a response to this stimulus. In the hypothalamus, 31 to 46 neurons were accelerated by hypercapnia. A high proportion of tested neurons in the posterior and lateral areas of the hypothalamus were excited by hypoxia, hypercapnia and pain or auditory stimuli. In addition to the effects on neuron firing, hypoxia and hypercapnia produced a rise in arterial pressure, bradycardia and an activation of the electrocorticogram. Similar changes were elicited by electrical stimulation of the sympathetic zone of the hypothalamus. It is suggested that the cerebrovascular supply may be regulated in part by sympathetic neurons in the hypothalamus responsive to hypoxia or hypercapnia. (Contractor's abstract)

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Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt Brit.).

UNIT ACTIVITY IN THE HYPOTHALAMUS OF THE CYCLIC FEMALE RAT: EFFECT OF GENITAL STIMULI AND PROGESTERONE, by C. A. Barraclough and B. A. Cross. [1962] [21]p. incl. illus. diagrs. tables, refs. (AFOSR-3953) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)301 and Public Health Service) AD 415825 Unclassified

Also published in Jour. Endocrinol., v. 26: 339-359, June 1963.

Unit activity in the hypothalamus and other diencephalic regions was recorded with stereotaxically oriented steel microelectrodes in adult female rats under light urethane anesthesia. Spontaneous firing rates of neurones varied from < 1 10 sec to 50 sec, but the majority fired at 1-10 sec. Some variations in the pattern of firing are described. Acceleration of firing rate was most readily induced by pain stimuli (64 % of neurones) and then by cold (60 %), probing the cervix (47 %), smell (20 %), light (5 %) and noise (3 %) in that order. A minority of neurones were inhibited by the stimuli. Many neurones responded to several different stimuli, most commonly by acceleration to cervical probing, cold and pain. Inhibitory convergence was also observed, e.g., blockade of the response to cervical probing by an olfactory stimulus, and inhibition by cervical probing of the response to cold or pain. The proportion of neurones excited by smell in prooestrous rats was more than double that in oestrous or dioestrous rats. Oestrous rats had relatively more neurones which were unresponsive or inhibited by the test stimuli. Slow intravenous injection of 400 µg.progesterone induced a selective depression of the response of lateral hypothalamic neurones to cervical probing. The effect was maximal at about 30 min and full recovery occurred in 1 hr. The possible significance of these observations is discussed with particular reference to the neural control of luteotrophin secretion.

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Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt. Brit.).

NERVOUS AND HORMONAL INFLUENCES ON THE RESPONSE OF SINGLE HYPOTHALAMIC NEURONES TO GENITAL STIMULATION IN THE RAT (Abstract), by C. A. Barraclough and B. A. Cross. [1962] [1]p. [AF 61(052)301] Unclassified

Presented at annual Conf. of the Society for the Study of Fertility, London (Gt. Brit.., June 27-30, 1962.

Published in Jour. Reprod. Fertil., v. 4: 213, Oct. 1962.

Microelectrodes were placed in the lateral hypothalamic area, and impulse activity in individual neurones to genital and sensory stimuli were displayed on an oscilloscope and simultaneously recorded with commentary on tape. The amplitude, waveform, and firing frequency of 306 neurones were examined and the percentage response to the various stimuli were computed. Results indicate that the cervix was the most sensitive site and with few exceptions neurones responding to genital stimuli were also affected by one or more other sensory modalities. Some interactions noted were: one stimuli suppressing the response to another, and a gradual loss of response to cervix stimulation produced by the slow intravenous injection of progesterone in propylene glycol. Control injections of propylene glycol were without effect.

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Carnegie Inst. of Tech. [Dept. of Mathematics] Pittsburgh, Pa.

BOUNDS FOR THE SOLUTIONS OF A CLASS OF NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS, by Z. Nehari. [1962] [8]p. (AFOSR-3342) (AF 49(638)227) AD 447673 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 829-836, Oct. 1963.

Let u be a solution of $\Delta u \geq f(u)$ in a sphere S: $x_1^2 + \ldots + x_n^2 < r^2$. The author obtains bounds for u at an arbitrary point of S for certain classes of functions f. An interesting special case of his results is the following upper bound for u(0): if log f(t) is nondecreasing and convex for all t, then $\int_{u(0)}^{\infty} dt/f(t) \geq r^2/4n$. (Math. Rev. abstract)

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Carnegie Inst. of Tech. [Dept. of Mathematics] Pittsburgh, Pa.

ON AN INEQUALITY OF LYAPUNOV, by Z. Nehari. [1962] [6]p. (AFOSR-3343) (AF 49(638)227) AD 414029 Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szegö, C. Loewner and others, Stanford U. Press, 1962, p. 256-261.

Using the methods of study of positive matrices, the following result is derived. Let $a_{ik}(x)$ (i, k = 1, ..., n) be continuous functions of x in the interval $a \leq x \leq b$, and set $A_{ik} = \int_a^b a_{ik}(x)\,dx$. If the system of differential equations $y_i'(x) = \sum_{k=1}^n a_{ik}(x)y_k(x)$ (i = 1, ..., n) has a solution $y_1(x), \ldots, y_n(x)$ such that every function $y_i(x)$ has a zero in [a, b] (but does not vanish there identically), then one of the roots of the equation $\det(A_{ik} - \lambda\delta_{ik}) = 0$ is larger than unity. This result is then used to derive, besides another, the following important theorem. Let $p_1(x)$ be real and continuous in $a \leq x \leq b$. If the differential equation $y^{(n)} + p_n(x)y^{(n-1)} + \ldots + p_1(x)y = 0$ has a non-trivial solution y(x) that has n zeros in [a, b], then $\sum_{k=1}^n 2^k(b-a)^{n-k}\int_a^b p_k(x)\,dx > 2^{n-1}$. This result is the analogue of Lyapunov's

well-known result for the second-order equation $y'' + p(x)y = 0$, that if $p(x)$ is continuous in $[a, b]$ and there is a solution $y(x)$ that vanishes at 2 points of $[a, b]$, then $y(x)$ satisfies the inequality $(b-a)^2 \int_a^b p(x)^2 dx > 4$. (Math. Rev. abstract)

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Carnegie Inst. of Tech. Dept. of Psychology, Pittsburgh, Pa.

THE EFFECT OF SYSTEMATIC AND NONSYSTEMATIC PRESENTATION OF STIMULI ON PERIPHERAL VISUAL ACUITY, by H. W. Karn, L. W. Gregg, and G. F. Pitz. [1962] [7]p. incl. diagrs. table. (AFOSR-2549) (AF 49-(638)770) Unclassified

Also published in Jour. Psychol., v. 53: 491-497, Apr. 1962.

The present investigation is one of a series of studies concerned with the role of experiential variables on the perceptual response. Viewing the acuity response as a perceptual phenomenon, the present experiment was designed to determine the effect of specific perceptual cue on acuity measures in the peripheral retina. The critical feature of the experiment was the systematic and nonsystematic presentation of acuity targets at varying exposure times. Differences obtained on systematic vs nonsystematic modes of presentation would indicate the presence of a specific experiential factor contributing to the perceptual act. The main conclusion drawn for these experiments is that, when called upon to make a visual acuity response, S will resort to behaviors which experience has shown will yield a maximum resolution of visual detail. Thus, the superior resolving power of the central over the peripheral retina causes S to view peripheral stimuli centrally, and prior knowledge of stimulus loci facilitates the perceptual act.

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Carnegie Inst. of Tech. [Dept. of Psychology] Pittsburgh, Pa.

PERCEPTUAL RESPONSE AS A FUNCTION OF THE SEQUENTIAL PROPERTIES OF MULTIPLE VISUAL STIMULI, by L. W. Gregg and H. W. Karn. [1962] [7]p. incl. diagrs. tables. (AFOSR-2913) (AF 49(638)-770; AD 414297 Unclassified

Also published in Jour. Exper. Psychol., v. 65: 124-130, Feb. 1963.

Circles located at the points of a triangle were differentially loaded with runs of dots and no dots averaging 2, 4, and 8 in length. Different combinations of loading and location were tachistoscopically presented to 3 experimental groups with a control group receiving random dot and no-dot combinations at all locations. Experimental groups performed significantly better in terms of error reduction than did the control group. However, variance analysis failed to show an effect of run length, per se. Despite the statistical results, an effect of run length is suggested by an analysis in which straight lines were fitted to the data by the method of least squares.

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Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.

PART I. NUCLEATION AND GROWTH IN DEPOSITION OF METALS FROM VAPOR AND OXIDATION OF ALLOYS. PART II. THE THERMODYNAMIC PROPERTIES OF SOLID GOLD-NICKEL ALLOYS AT 775-935°C, by R. D. Gretz, G. M. Pound and others. Final rept. June 30, 1962 [37]p. incl. diagrs. tables, refs. (AFOSR-3007) (AF 18(600)1572) AD 278068 Unclassified

Part I. The time required to build up a critical concentration of adsorbed Ag on a tungsten substrate has been measured for several impingent fluxes. The following conclusions have been made from observations: (1) Ag increases or decreases the work function of the substrate depending on which area of the substrate is observed. (2) Work function changes due to adsorption are the same for all impingent fluxes used, but occur either sooner or later depending on whether the flux is large or small; (3) Ag diffuses to the side of the substrate which is not in the direct path of the impingent beam; (4) The initial site at which nucleation occurs is approximately the (310) plane of the substrate; (5) The apparent critical concentration of adsorbate required to produce nucleation decreases with increasing impingent flux, tending to an asymptotic value of 1.5×10^{14} atoms cm^2 sec; and (6) The true critical concentration required to produce nucleation is the same for all fluxes and is 1.5×10^{14} atoms cm^2 sec. Part II. Emf measurements have been made on 10 Au-Ni alloys at temperatures 775°, 825°, 900°, and 935°C. The derived activities of both Ni and Au show large positive deviations for Raoult's law. The enthalpies of mixing are positive, and both the free energy and entropy of mixing are positively in excess of the ideal values at all compositions. These results are consistent with the miscibility gap in the system and are qualitatively interpreted in terms of the large size difference and electronic interactions between Au and Ni. Tabulated values of the activities, free energies, entropies, and enthalpies of mixing are given in the appendix. (Contractor's abstract, modified)

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Carnegie Inst. of Tech. [Metals Research Lab.] Pittsburgh, Pa.

NUCLEATION IN THE SOLIDIFICATION OF METALS, by G. M. Pound. [1957] [19]p. incl. diagrs. table, refs. (AFOSR-3591) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1572, Office of Naval Research, and United Engineering Foundation) Unclassified

Also published in Seminar on Liquid Metals and Solidification. Chicago, Ill. (Nov. 2-8, 1957), Cleveland, Amer. Soc. for Metals, 1958, p. 87-105.

For abstract see item no. CAR 08:007, Vol. II.

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Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.

THERMAL ETCH PITS AT DISLOCATIONS IN LITHIUM FLUORIDE, by T. Ejima, J. P. Hirth, and W. H. Robinson. Sept. 10, 1962 [12]p. (AFOSR-958) (Also bound with its AFOSR-3994; AD 290305) (AF 49-(638)551) Unclassified

A study of the thermal etching of lithium fluoride has shown that, under certain conditions of temperature, pressure, and time, thermal etch pits can be produced at dislocation sides on the surface of lithium fluoride. The dependence of the pits on these conditions and their development is correlated with the theory of crystal dissolution. The existence of the thermal etch pits at dislocation sites has been correlated with chemical etch pits formed at dislocation sites in lithium fluoride. A treatment of the nucleation of a disc-shaped hole in a low index surface at a dislocation is given.

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Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.

MECHANISM OF EVAPORATION OF METAL CRYSTALS, by W. H. Robinson. Final rept. Sept. 10, 1962 [65]p. incl. illus. diagrs. tables, refs. (AFOSR-3994) (AF 49(638)551; AD 290305 Unclassified

The objective of this research is to determine quantitatively the evaporation rates from single crystal and polycrystal metal surfaces as a function of time, temperature, crystal orientation, and degree of crystal perfection. Results are compared with theoretical prediction. The method of investigation includes a study of thermal etching with the formation of etch pits at the sites of dislocations in the crystals. This aspect of the study is correlated with x-ray studies to determine crystal perfection.

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Carnegie Inst. of Tech. [Metals Research Lab.] Pittsburgh, Pa.

A CHEMICAL POLISHING TECHNIQUE FOR SILVER, by H. J. Levinstein and W. H. Robinson. [1962] [2]p. incl. illus. (AFOSR-4475) (AF 49(638)551) AD 295954 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 1292-1293, Dec. 1962.

A method of chemically polishing Ag for metallographic examination has been developed. The samples are prepared by polishing on 0, 2 0, 3 0 paper. They are then polished on 600 micro-cut paper, followed by a final mechanical polish on a cloth containing 5 μ diamond paste. The samples are then chemically polished in a solution of 100 cc of saturated chromic acid and 5 cc of a 5% HCl solution. The chemical polishing is performed by swabbing with a cotton ball saturated with the solution. During the chemical polishing, the sample is rinsed frequently in running water. Polishing in this manner for 5 min is sufficient to remove the strained material from the previous polishing operations. The amount of material removed is approximately 4 μ min. The surface obtained is flat and free of pits. If the solution employed is of improper HCl content, an interference color film will form on the sample. This film can be removed either by swabbing with a cotton ball saturated with ortho-phosphoric acid or by wiping the surface under running water with a soft tissue

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Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.

ETCH PITS AT DISLOCATIONS IN SILVER SINGLE CRYSTALS, by H. J. Levinstein and W. H. Robinson. [1962] [4]p. incl. illus. refs. (AFOSR-J15 (AF 49-(638)551) AD 297114 Unclassified

Also published in Jour. Appl. Phys., v. 33: 3149-3151, Nov. 1962.

A chemical etching solution has been found which results in etch pit formation at dislocations in the {100} and {111} surfaces of silver single crystals. Etch pits as small as 500 to 2000A may be obtained in the {111} surface of silver permitting the observation of dislocation densities of as high as 10^{10} lines cm^{2}. The slip band structure of deformed silver has been examined by this technique and has been found to be cellular in appearance. Contractor's abstract

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Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.

DISLOCATION CONFIGURATIONS IN DEFORMED SILVER SINGLE CRYSTALS, by H. J. Levinstein and W. H. Robinson. Sept. 10, 1962 [33]p. incl. illus. diagrs. table, refs. (Also bound with its AFOSR-3994; AD 290305) (AF 49(638)551) Unclassified

Published in The Relation Between the Structure and Mechanical Properties of Metals. Proc. of the Conf., Teddington (Gt. Brit.) (Jan. 7-9, 1963), London, Her Majesty's Stationery Office, v. 1: 179-203, 1963

Silver single crystals oriented for single slip were deformed incrementally in both simple shear and tension, and the dislocation arrangements were observed after each increment of strain by optical examination of the etch pitted surface or by examining replicas of these surfaces by electron microscopy. In addition, some observations were made on specimens deformed in compression. For a given specimen, several increments of strain were made during Stage I of the deformation and also during stage II. Stage I is characterized by slip bands consisting of clusters of dislocations which are cellular in appearance, that is regions having high dislocation density arranged in cell walls, or boundaries surrounding regions of very low dislocation density. As deformation in stage I progressed, the number of

slip bands increased while the width of the bands remained virtually constant at a size depending on the initial dislocation density of the as-grown crystal. Stage II of the deformation curve began when the entire gauge length of the specimen had acquired a uniform cellular array of dislocations of the same density as in the slip bands occurring initially in stage I. The cellular arrangement of dislocations persists throughout stage II, the size of the clusters decreasing with increasing strain.

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Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

LOW TEMPERATURE STUDY OF THE ELECTRONIC BAND STRUCTURE OF METALS AND THEIR DILUTE ALLOYS, by W. L. Gordon and T. G. Eck. Final rept. Jan. 1962 [42]p. incl. illus. diagrs. refs. (AFOSR-2041. (AF 49(638)-621: AD 273018 Unclassified

The original objective of this research was to investigate the band structure of several pure metals through the combined techniques of de Haas-van Alphen (DHVA) effect and cyclotron resonance of the type suggested by Azbel and Kaner. With this information available, it was hoped that DHVA studies in sufficiently dilute alloys of these metals would permit a study of the changes in band structure with alloying. A combination of interesting and useful results in pure metals together with difficulty in preparation of metallurgically trustworthy alloy single crystals led to a shift of emphasis to pure metals. At the same time, another tool for studying band structure was employed, galvanomagnetic effects, particularly the variation with magnetic field strength of the components of electric field parallel and transverse to the electric current in the limit of high magnetic field.

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Case Inst. of Tech. Dept. of Physics, Cleveland, Ohio.

MAGNETORESISTANCE INVESTIGATION OF THE FERMI SURFACE OF MAGNESIUM, by R. W. Stark, T. G. Eck and others. [1962] [3]p. incl. diagrs. AFOSR-3120) (AF AFOSR-62-222) AD 613857 Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 231, Mar. 26, 1962 (Title varies)

Also published in Phys. Rev. Ltrs., v. 8: 360-362, May 1, 1962.

A detailed study of the transverse magnetoresistance of several single-crystal specimens of magnesium has been made in fields up to 22000 gauss. The residual-resistance ratios ($R_{300\,^{\circ}K}$ $R_{4.2\,^{\circ}K}$) of these specimens were in the range from 450 to 900. The results of this study are in agreement with the gross features reported by Alekseevskii and Gaidukov. Results are interpreted in terms of the nearly-free-electron model of the Fermi surface as modified by the unpublished band calculation of L. Falicov. The connectivity of the hole arms along the hexagonal axis due to spin-orbit coupling as discussed by Cohen and Falicov, does not appear to be present at these magnetic fields.

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Case Inst. of Tech. Dept. of Physics, Cleveland, Ohio.

OSCILLATORY MAGNETIC BREAKDOWN IN ZINC, by R. W. Stark. [1962] [4]p. incl. diagrs. (AFOSR-J562) (AF AFOSR-62-222) AD 412694 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 482-485, Dec. 15, 1962.

The results of transverse magnetoresistance studies of single crystals of Zn are reported. An argument is given to infer that periodic magnetic breakdown occurs, which accounts for the large amplitude of the Shubnikov-de Haas effect. The part played by the needle portion of the third band electron surface is discussed in detail.

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Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

GALVANOMAGNETIC PROPERTIES AND FERMI SURFACE OF ZINC (Abstract), by R. W. Stark. [1962] [1]p. [AF AFOSR-62-222] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio. Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 546. Nov. 23, 1962.

A detailed investigation of the galvanomagnetic properties of several single-crystal specimens of Zn has been completed in magnetic-field strengths of 23000 G. These specimens all had residual-resistance ratios ($R_{300\,^{\circ}K}$ $R_{4.2\,^{\circ}K}$) of 23000. The results of this investigation indicate that the Fermi surface of Zn supports discrete bands of open trajectories along the [0001], [10$\bar{1}$0], and [11$\bar{2}$0] directions. An additional solid angle of magnetic-field directions within 1.3° of the c axis produces open trajectories parallel to the basal plane. This same small solid angle of magnetic-field directions gives rise to de Haas-Schubnikov oscillations in the transverse magnetoresistance, which are of unexpectedly large amplitude. The data, including the large amplitude of the de Haas-Schubnikov oscillations, can be explained on the basis of a free-electron model for the Fermi surface of Zn modified to include magnetic breakdown effects between the second-band hole surface and the third-band electron surfaces, such as those already observed in Mg.

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Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

LOW-FIELD de HAAS-van ALPHEN STUDIES OF BERYLLIUM (Abstract), by R. Gensberg [1962] [1]p. [AF AFOSR-62-222] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 546, Nov. 23, 1962.

Portions of the Fermi surface of Be have been studied by de Haas-van Alphen methods in magnetic fields up to 23 kG over the temperature range of 2° to 4.2°K. A null-deflection torsion balance was employed to present automatic recording of the oscillations in the diamagnetic susceptibility as a function of field. There are 2 groups of strong oscillations present: one having maximum period 9×10^{-6} G^{-1} arising from nearly cylindrical sections lying in the basal plane, and the other corresponding to 2 extremal portions with maximum periods of 10.2×10^{-8} and 10.5×10^{-8} observed with H along the hexagonal axis in crystals of sufficiently high purity (R_{300} $R_{4.2°K}$ of 200 or higher). Other groups of oscillations appear with much lower amplitude. A more complete description is presented of all the Fermi surface portions observed. Preliminary results of other investigators also show isolated periods in these ranges.

515

Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

EXACT POWER OF SOME TESTS BASED ON A GENERALIZATION OF MOOD'S STATISTICS (Abstract), by F. C. Leone, I. M. Chakravarti, and G. E. Haynam. [1962] [1]p. [AF 49(638)361] Unclassified

Presented at annual meeting of the Inst. Math. Stat., Minneapolis, Minn., Sept. 7-10, 1962.

Published in Ann. Math. Stat., v. 33: 1496, Dec. 1962.

The exact power of Mood's test based on the median of c combined samples is developed. The power function for the median test is obtained for alternatives of translations of the exponential distribution as well as alternatives of change in location and scale of the rectangular distribution. These powers are compared with the 2-sample case developed earlier. Tables of the power for selected values of a sample size are presented.

516

Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

TABLES OF NON-CENTRAL CHI-SQUARE (Abstract), by G. E. Haynam and F. C. Leone. [1962] [2]p. [AF 49(638)361] Unclassified

Presented at annual meeting of the Inst. Math. Stat., Minneapolis, Minn., Sept. 7-10, 1962.

Published in Ann. Math. Stat., v. 33: 1491-1492, Dec. 1962.

Three tables of the cumulative non-central chi-square have been computed. These cover a range of values of non-centrality parameter from 0 to 34 and of degrees of freedom from 1 to 100. Further, the power of the non-central chi-square distribution has been computed for selected values of alpha ranging from 0.001 to 0.1. The construction and use of these tables is discussed.

517

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

RECURRENCE RELATIONS FOR THE FIRST TWO INVERSE MOMENTS OF THE POSITIVE BINOMIAL VARIABLE, by Z. Govindarajulu. May 1962, 6p. incl. table. (Publication no. 1063) (AFOSR-3162) (AF AFOSR-62-72) AD 285527 Unclassified

Also published in Jour. Amer. Stat. Assoc., v. 58: 468-473, June 1963. (Title varies)

Recurrence formula for the second inverse moments of the positive binomial variable was derived. The method of obtaining recurrence formulae for its higher inverse moments was indicated. The cumulative rounding error propagated by using these formulae recurrently was considered. Bounds for the propagated rounding error were obtained. By comparing some of the moments evaluated by the use of recurrence formulae, with the true values, it is noted that the rounding error involved in the first 2 inverse moments will be at most 1 unit in the last decimal place and the error will be practically zero when p is large. (Contractor's abstract)

518

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

THE FIRST TWO MOMENTS OF THE RECIPROCAL OF THE POSITIVE HYPERGEOMETRIC VARIABLE, by Z. Govindarajulu. May 1962 [44]p. incl. tables. (Publication no. 1061) (AFOSR-3163) (AF AFOSR-62-72) AD 281730 Unclassified

Starting from the definitions, the first 2 inverse moments of a positive hypergeometric variable have been computed accurate to 5 decimal places for: N = 1(1)20, M = 1(1)N, n = 1(1)M; N = 25(5)50, M, N = 5%(5%)100%, n = 1(1)M; N = 55(5)100(10)140, M, N = 5%(5%)100%, n, N (< M, N) = 5%(5%)100%. Many theoretical results of interest, recurrence formulae among the inverse moments, and various approximations for the first 2 inverse moments have been obtained. The rounding error involved in using the formulae recurrently, in order to compute the moments, is at most 1-2 units in the last decimal place. The approximate values have been compared with the true values for some sets of values of N, M and n. For large values of N and n, the Beta approximations are accurate up to 2-3 decimal places, provided they exist. (Contractor's abstract)

519

Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

EXACT POWER OF SOME TWO-SAMPLE AND C-SAMPLE NON-PARAMAGNETIC STATISTICAL PROCEDURES, by G. E. Haynam. Doctoral thesis, June 1962, 103p. incl. diagrs. tables, refs. (Rept. no. 1064) (AFCSR-3164) (AF AFOSR-62-72) Unclassified

Expressions for the exact power of the 2-sample Mann-Whitney-Wilcoxon U test procedure against alternatives of exponential and rectangular populations have been derived. Several examples for total sample sizes of 11 and 15 have been compared with Mood's median test. Mood's test is more powerful than the U test in all instances in which the number of observations from the null population exceeds the number from the alternative population. The converse is true when the number of observations from the null population is less than the number from the alternative. Expressions for the asymptotic efficiency of the Mann-Whitney-Wilxoxon U test relative to Mood's and Massey's tests and the likelihood ratio test have been derived for exponential populations. The asymptotic efficiency of the U test relative to the likelihood ratio test is zero. Mood's and Massey's test procedures for 2 samples have been extended to the case of discriminating among populations on the basis of c ordered samples. Expressions for the exact power have been derived for Mood's test with exponential and rectangular populations and for Massey's test with exponential populations. With exponential translation alternatives, the tests are biased. The exact null distributions of goodness of fit tests for 1-way and 2-way contingency tables indicate that even for samples as small as 10, the exact distribution is closely approximated by a chi-square distribution with the appropriate degrees of freedom. (Contractor's abstract)

520

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

RELATIONSHIPS BETWEEN MOMENTS OF NORMAL AND CHI (1 D. F.) ORDER STATISTICS, by Z. Govindarajulu. Mar. 1962, 13p. (Publication no. 1057) (AFOSR-3340) (AF AFOSR-62-72) Unclassified

Formulae expressing the (regular and mixed) moments of order statistics and expected values of the quasi-ranges in samples from the standard normal population, purely in terms of the moments of order statistics in samples from the folded-standard-normal population or chi-population with 1 d. f., have been derived. Only certain moments of chi-order statistics can be expressed in terms of the moments of the normal order statistics. The cumulative rounding error involved in using these formulae recursively, has been studied. (Contractor's abstract)

521

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

TABLES OF THE CUMULATIVE NON-CENTRAL CHI-SQUARE DISTRIBUTION, by G. E. Haynam, Z. Govindarajulu, and F. C. Leone. Nov. 1962, 89p. incl. tables. (Publication no. 104) (AFOSR-4620) (AF AFOSR-62-72) AD 426500 Unclassified

Three extensive tables related to the cumulative non-central chi-square distribution are presented: (1) the power of the non-central chi-square distribution; (2) the non-centrality parameter of the non-central chi-square distribution; and (3) the degrees of freedom of the non-central chi-square distribution. Also, a short discussion of the errors involved in the computation is presented. (Contractor's abstract)

522

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

PERCENTILE POINTS OF ORDER STATISTICS IN SAMPLES FROM BETA, NORMAL, CHI (1 D. F.) POPULATIONS, by Z. Govindarajulu and N. W. Hubacker. Nov. 1962, 41p. incl. tables, refs. (Publication no. 101) (AFOSR-4698) (AF AFOSR-62-72) AD 296221 Unclassified

If $p(\alpha, i, N)$ denotes the αth probability point of the ith smallest order statistic in random samples of size N drawn from the Beta distribution, $I(\alpha, i, N)$ is computed accurate to 8 decimal places for $N = 1(1)30(5)60$, $i = 1(1)1+[N/2]$ and $\alpha = 0.01, 0.02, 0.10, 0.25, 0.50, 0.75, 0.90, 0.975, 0.99$. Also, the 25th, 50th and 75th percentile points of the Beta distribution for $N = 65(5)100$, $i = 1(1)1+[N/2]$ are computed with the same accuracy. Using the above values the percentile points of the normal, chi (1 d.f.) and Weibull order statistics in samples of sizes up to and including 30 are computed accurate to 4 or 5 decimal places. (Contractor's abstract, modified)

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Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

BEST LINEAR UNBIASED ESTIMATION OF LOCATION AND SCALE PARAMETERS OF WEIBULL DISTRIBUTION USING ORDERED OBSERVATIONS, by Z. Govindarajulu and M. Joshi. Nov. 1962, 37p. incl. tables, refs. (Publication no. 102) (AFOSR-4699) (AF AFOSR-62-72) AD 296220 Unclassified

Best linear unbiased estimation of location and scale parameters of the Weibull distributions using ordered observations of a random sample is considered. It is assumed that the shape parameter of the Weibull distribution is known. For sample sizes up to and including 5, all possible censoring is considered. For sample sizes greater than 5, one-sided censoring is considered. The coefficients are tabulated. For each sample size and the value of the shape parameter, the first row of coefficients corresponds to the best linear unbiased of the location parameter and the second row of coefficients

corresponds to the best estimation of the scale parameter. The expected values and the variances of the Weibull order statistics are computed accurate to 4 or 5 decimal places. For each combination of N and i, the first row gives the expected values and the second row gives the variances. Product moments and covariances are presented. The accuracy is 4 to 5 decimal places except for sample sizes 11 and 12 where the accuracy is 3 decimal places. Each column of values corresponds to a certain value of the shape parameter. Throughout, the same values of practical interest are considered for the shape parameter of the Weibull distribution. (Contractor's abstract, modified)

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Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

RECURRENCE RELATIONS FOR THE FIRST TWO INVERSE MOMENTS OF THE POSITIVE BIMONIAL VARIABLE, by Z. Govindarajulu. May 1962, 6p. incl. table. (Publication no. 1063) (AFOSR-64-0206) (AF AFOSR-62-72) AD 432568 Unclassified

Also published in Jour. Amer. Stat. Assoc., v. 58: 468-473, June 1963. (Title varies)

For abstract see item no. 517, Vol. VI.

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Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

CUMULATIVE SUM CONTROL CHARTS. MATHEMATICAL PRINCIPLES APPLIED TO THEIR CONSTRUCTION AND USE. PART I, by N. L. Johnson and F. C. Leone. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-65-2603, pt. 1) (AF AFOSR-62-72) AD 628431 Unclassified

Also published in Indus. Quality Control, v. 18: 15-21, June 1962.

The cumulative sum control chart (CSCC) is considered in relation to the standard Shewhart control chart. The authors in no way contend that the CSCC will replace the standard control chart, but show that it has definite areas of applicability. In particular, by comparison of average run length (ARL) for different types of charts, some indication is given as to the situations in which one system is likely to be advantageous as compared with the other. It appears that the CSCC is especially well adapted to detecting abrupt changes in a parameter value (e.g., in mean or in proportion defective).

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Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

CUMULATIVE SUM CONTROL CHARTS. MATHEMATICAL PRINCIPLES APPLIED TO THEIR CONSTRUCTION AND USE. PART II, by N. L. Johnson and F. C. Leone. [1962] [8]p. incl. diagrs. tables. (AFOSR-65-2603, pt. 2) (AF AFOSR-62-72) AD 628431 Unclassified

Also published in Indus. Quality Control, v. 19: 29-36, July 1962.

Cumulative sum control charts based on sample variances, and ranges are considered. In the case of variances, a rather general technique is described which allows incorporation of results from samples of different sizes in the same CSCC. For ranges, the usual case of uniform sample size is treated.

527

Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

CUMULATIVE SUM CONTROL CHARTS. MATHEMATICAL PRINCIPLES APPLIED TO THEIR CONSTRUCTION AND USE. PART III, by N. L. Johnson and F. C. Leone. [1962] [7]p. incl. diagrs. tables. (AFOSR-65-2603, pt. 3) (AF AFOSR-62-72) AD 628431 Unclassified

Also published in Indus. Quality Control, v. 19: 22-28, Aug. 1962.

An example is presented comparing cumulative sum control (Poisson and binomial variables) and standrad range charts. Tables are given to aid in selecting parameters for constructing a mask for control limits.

528

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

THE INFLUENCE OF WATER ON THE RATE OF TRANSMISSION OF HYDROGEN THROUGH PALLADIUM, by W. E. Reid, Jr. 1962, 50p. incl. diagrs. tables, refs. (AFOSR-4682) (AF 49(638)475) AD 408357 Unclassified

The transmission rate of H_2 through Pd was studied by electrodepositing H_2 on the surface of thin Pd foils and determining the evolution rate on the opposite side of the foils. The transmission rates were studied as functions of current density and foil thickness for environments of dry H_2 at 1 atm and liquid water respectively on the diffusion side of the foils. The Pd foil separated 2 compartments of a Teflon cell. The polarization compartment contained 2N H_2SO_4 saturated with H_2 at 1 atm. The steady state evolution of H_2 from the diffusion side of the foils was measured volumetrically as a function of the polarization or deposition current i and expressed equivalently as a current j. The resulting curves had an initial straight line portion and became more horizontal at higher values of current density. The reciprocal values of the initial slopes as well as the values of $i_{j_{max}}$ varied linearly with foil thickness. The transmission rates at the higher current densities for H_2 at 1 atm on the diffusion side of the foils were approximately 3 times those obtained when water was on the diffusion side. A comparison of possible mechanisms for the H_2 evolution reaction on palladium indicates that the slow step in this reaction is the discharge of

hydronium ions. If H_2 at 1 atm is on the diffusion side of the foil, the calculated value of the diffusion coefficient is $D = 3.16 \times 10^{-7}$ cm^2 sec at 25°C. This value is in good agreement with the value used by Barrer using the time lag method. If water is on the diffusion side of the foil, the calculated value is $D = 0.42 \times 10^{-7}$ cm^2 sec at 25°C. (Contractor's abstract)

529

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

THE MAXIMUM RATE OF DIFFUSION OF ELECTROLYTIC HYDROGEN THROUGH PALLADIUM AND PALLADIUM-SILVER ALLOY DIAPHRAGMS, by J. A. Pauley. 1962 [37]p. incl. diagrs. tables, refs. (AFOSR-4683) (AF 49(638)475) AD 407019 Unclassified

The limiting current of H_2 through Pd and Ag-Pd alloys was measured and was found to decrease with increasing Ag content of the alloy and with the thickness of the diaphragm. The diffusion coefficient was calculated for Pd and the 20% and 30% Ag-Pd alloys and the values of the exchange currents, i_{40}, for various values of θ (fraction of the surface sites available for H_2 adsorption) were calculated. The results of these computations are presented in table form. Increasing the Ag content of the alloy decreases the rate of the jump of H_2 into the bulk of the metal and this step assumes greater importance in the diffusion of H_2 through Pd as the Ag content is increased to 30%.

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Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

THE EFFECT OF TEMPERATURE AND PRESSURE ON THE MAXIMUM DIFFUSION RATE OF HYDROGEN THROUGH PALLADIUM, by P. L. Damour. 1962, 54p incl. diagrs. tables, refs. (AFOSR-4685) (AF 49(638)-475) AD 407670 Unclassified

The transmission rate of H_2 through Pd foil has been studied for a series of foil thickness at 4 temperatures and 4 pressures. The results support the assumption that the rate of the combination reaction of H_2 atoms on the face of the foil is extremely large. Proof is presented that as the foil becomes poisoned this surface combination reaction is retarded, and can be slowed down to such a value that the penetration reaction becomes the fastest. The diffusion constant, D, was evaluated; the extrapolated value at 25°C is $D = 8.1 \times 10^{-7}$ cm^2 sec. The activation energy of the diffusion reaction was found to be 6.6 ± 1.0 kcal. The diffusion constant over the temperature range, 5.6° to 15.3°C, is represented by $D = 0.023 \exp(-6600/RT)$ cm^2 sec.

531

Catholic U. of America. [Dept. of Mathematics] Washington, D. C.

ON A FACTORIZATION OF CHARACTERISTIC FUNCTIONS WHICH HAVE A FINITE NUMBER OF DERIVATIVES AT THE ORIGIN, by R. G. Laha and E. Lukacs. [1962] [4]p. (AFOSR-J626) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-32 and National Science Foundation) AD 415195 Unclassified

Also published in Pub. Inst. Stat. Univ. Paris, v. 11: 221-224, 1962.

The following theorem is proved: If f(t) is a characteristic function with derivatives up to the even order 2N at the origin and if $f(t) = [f_1(t)]^{\alpha_1}[f_2(t)]^{\alpha_2} \ldots [f_n(t)]^{\alpha_n}$, where each $f_j(t)$ is also a characteristic function and $\alpha_j > 0$ $(j = 1, 2, \ldots, n)$, then each $f_j(t)$ has derivatives up to order 2N at the origin. The case $\alpha_1 = \alpha_2 = \ldots = \alpha_n = 1$ is Devinatz's theorem. (Math. Rev. abstract)

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Catholic U. of America. [Dept. of Mathematics] Washington, D. C.

ON IDENTICALLY DISTRIBUTED STOCHASTIC INTEGRALS, by R. G. Laha and E. Lukacs. [1962] [8]p. (AFOSR-64-1607) (sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-32 and National Science Foundation) AD 446898 Unclassified

Also published in Trans. Third Prague Conf. on Information Theory, Statistical Decision Functions, Random Processes, Liblice [Czechoslovakia] (June 5-13, 1962), Prague, Czechoslovak Academy of Sciences, 1964, p. 467-474.

Let $X(t)$, $t \in [a, b] \subset R$, be a process with independent increments, all moments finite, and mean value and variance functions of bounded variation on $[a, b]$. Form the integrals in quadratic mean $Y = \int_a^b a(t)dX(t)$, $Z = \int_a^b b(t)dX(t)$, where $a(t)$ and $b(t)$ are continuous in $t \in [a, b]$ with $\max_t |a(t)| \neq \max_t |b(t)|$. It is proved that Y and Z are identically distributed if and only if X(t) is a Wiener process and $\int_a^b [a(t)]^k dt = \int_a^b [b(t)]^k dt$ for $k = 1$ and 2. Then a similar theorem is established for $t \in [a, \infty]$. (Math. Rev. abstract)

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Catholic U. of America. Dept. of Physics, Washington, D. C.

QUANTUM MECHANICS OF BEATS BETWEEN WEAKLY COUPLED OSCILLATORS, by P. H. E. Meijer and T. Tanaka. [1962] [5]p. (AFOSR-3556) (AF 49(638)452) AD 408580 Unclassified

Also published in Amer. Jour. Phys., v. 31: 161-165, Mar. 1963.

Although the weakly coupled double pendulum seems to be a standard illustration in classical mechanics, it is seldom mentioned in quantum mechanics. It shares this fate with the damped harmonic oscillator, but while there is a good reason for avoiding the last one in quantum mechanics, the first can be treated with the same procedure as in classical mechanics. The exact solution is then compared with the solutions obtained by time-independent and time-dependent perturbation methods. It turns out that there are some additional steps to be taken, compared to the usual textbook treatment of the time-independent perturbation theory, due to the fact that all the levels of the unperturbed problem are degenerate. It is shown that the diagonalization of the secular matrix in the time-independent problem is equivalent to a problem of rotation of angular momentum operators in function space. The time-dependent problem needs, again, additional steps due to the degeneracy, and it yields the well-known beat-behavior. (Contractor's abstract)

534

Catholic U. of America. [Dept. of Physics] Washington, D. C.

CONFIGURATION INTERACTION IN Be_2 (Abstract), by H. C. Warren and V. F. Griffing. [1962] [1]p. [AF 49-(638)906] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 204, Mar. 26, 1962.

The energy of a single-determinant $^1\Sigma_g^+$, ground-state, wave function for Be_2 was improved by superposition of determinant spin configurations constructed using virtual orbitals from the same ground-state, SCF calculations. Coefficients and molecular energy were obtained by the variational procedure at each of seven internuclear distances, and for superpositions of 10, 15, 20, 25, 30, and 37 configurations. Binding in the ground state was indicated when up to 20 configurations were mixed, but disappeared upon more-extensive mixing. The ground-state energy at the largest distance closely approached the spectroscopically determined energy of 2 unexcited, beryllium atoms. Some stable, excited $^1\Sigma_g^+$ states were indicated. The same virtual orbitals were used to construct configurations of $^3\Pi_g$, $^3\Pi_u$, $^3\Sigma_g^+$, and $^3\Sigma_u^+$ symmetries. For each of these, the lowest-lying state resulting from mixing configurations at the largest distance approached to within 1 ev the energy of the separate atoms calculated from spectroscopic data. Some stable, triplet states were indicated.

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Catholic U. of America. [Dept. of Physics] Washington, D. C.

MOLECULAR ORBITAL STUDY OF THE SYMMETRIC LINEAR H_4 COMPLEX (Abstract), by P. F. Piper and V. F. Griffing. [1962] [1]p. [AF 49(638)906] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys Soc., Series II, v. 7: 204, Mar. 26, 1962.

LCAO-MO-SCF calculations of the energies of a series of symmetric, linear configurations of H_4 in the $^1\Sigma_g^+$ state were carried out on a digital computer in order to obtain improved, approximate, wave functions. Molecular orbitals were constructed as linear combinations of modified Slater orbitals for the following sets of atomic-basis functions: 1s on each nucleus, 1s and $2p\sigma$ on each nucleus, and 1s, 2s, $2p\sigma$ and $2p\pi$ on each nucleus. For each of the AO's, the value 1.1 was used for the screening parameter. It was found that, using 1s AO's only, the energy was lowered with respect to a previous claculation done with the screening parameter equal to 1. The virtual orbitals obtained from the SCF calculation on the extended-basis set are being used to construct determinantal spin functions for a ground-state configuration-interaction study.

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Catholic U. of America. [Dept. of Physics] Washington, D. C.

THEORETICAL INVESTIGATION OF THE GROUND STATE OF LINEAR H_3 (Abstract), by S. H. Brown and V. F. Griffing. [1962] [1]p. [AF 49(638)906] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 204, Mar. 26, 1962.

The approximate wave functions and molecular energies of the state of H_3 are now being calculated by making linear combinations of configurations which are constructed using virtual orbitals from a single, ground-state, LCAO-MO-SCF calculation. These are based on modified Slater-type 1s, 2s, $2p\sigma$, $2p\pi$ atomic orbitals. Thirty-eight configurations are taken for 4 internuclear distances of asymmetric H_3 and 6 internuclear distances of symmetric H_3.

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Catholic U. of America. Dept. of Physics, Washington, D. C.

PARTIAL AND TOTAL CAPTURE PROBABILITIES OF NEGATIVE MUONS BY C^{12}, by M. Ruel and J. G. Brennan. [1962] [4]p. incl. tables, refs. (AFOSR-J317) (AF AFOSR-62-56) AD 408026 Unclassified

Also published in Phys. Rev., v. 129: 866-869, Jan. 15, 1963

The capture probability of negative muons by the C^{12} nucleus is calculated as a sum of partial transition rates to the individual levels of B^{12}. The calculation is based on an extreme single-particle shell model. The calculation is in application of the general formalism developed by Morita and Fujii for predicting the transition rate between 2 definite nuclear states, following muon capture. Regarding bound-state captures, the agreement between theory and experiment is good. An exception is the prediction concerning the 1.67-mev level of B^{12}, the calculated transition rate being too large by a factor whose lower limit is about 2. This casts some doubt on the spin and parity assignments currently accepted for this level. The total capture probability is too small by a factor of 2, as is the ratio of unbound-to-bound captures. The discrepancy is accounted for in part by the existence of little-known, highly excited virtual state of B^{12}. These conclusions are of limited scope because of the use of the single-particle shell model.

Catholic U. of Brazil, Rio de Janeiro
see Pontifical Catholic U. of Rio de Janeiro (Brazil).

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Catholic U. of Chile. Lab. of Physiology, Santiago.

THE IN VITRO EFFECT OF PROGESTERONE AND ESTROGENS ON THE OXYTOCIN RESPONSE OF RAT UTERUS, by L. Barnafi and H. Croxatto. [1962] [4]p. incl. diagrs. (AFOSR-1941) (AF 49(638)584) Unclassified

Also published in Acta Physiol. Latinoamer., v. 13: 26-29, 1963.

The in vitro effect of progesterone, estrogens, testosterone, and desoxycorticosterone acetate was studied on 32 isolated non-pregnant rat uteri before and after oxytocin stimulation. All of these substances block the response to oxytocin. It is suggested that this inhibitory effect is due to a change on the premeability of the myometrial cell membrane.

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Catholic U. of Chile. Lab. of Physiology, Santiago.

THE IN VITRO EFFECT OF PROGESTERONE AND ESTROGENS ON THE OXYTOCIN RESPONSE OF RAT UTERUS, by L. Barnafi and H. Croxatto. [1962] [4]p. incl. diagrs. (AFOSR-64-0100) (AF 49(638)-34) AD 429379 Unclassified

Also published in Acta Physiol. Latinoamer., v. 13: 26-29, 1963.

For abstract see item no. 538, Vol. VI.

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Centre National de la Recherche Scientifique, Paris (France).

[PLATEAUS OF DEPOLARIZATION AND PAROXYSTICAL RATES OF POINTS IN HYPERTHERMIA IN CERTAIN IDENTIFIABLE NEURONES OF APLYSIA] Plateaux de depolarisation et trains paroxystiques de pointes en hyperthermie, sur certains neurones identifiables d'Aplysia, by A. Arvanitaki-Chalazonitis. [1962] [3]p. incl. illus. (AFOSR-4173) (AF EOAR-61-30) Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 255: 1523-1525, Sept. 24, 1962.

The cause of paroxytic-hyperpolarization point—plateau-discharge activity determined by hyperthermia on certain identifiable neurones of Aplysia is attributed to the differential effects of temperature on cellular loci with distinct cytostructural characteristics. (Contractor's abstract)

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Centre National de la Recherche Scientifique, Paris (France).

[THERMIC INHIBITION OF SLOW ELECTRIC WAVES OF A GIANT IDENTIFIABLE NEURON] Inhibition thermique des ondes electriques lentes d'un neurone géant identifiable (Neurone Br d'Aplysia fasciata), by N. Chalazonitis. [1962] [2]p. incl. illus. (AFOSR-4338) (AF EOAR-61-30) Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 255: 1652-1653, Oct. 1, 1963.

The identifiable soma of type Br revealed, by hypothermia, the origin of large hyperpolarization potentials which are capable of reaching 30 mev. These potentials inhibit all activity in the cell for several minutes. The effect is reversible by returning to the initial temperature. (Contractor's abstract)

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Centre National de la Recherche Scientifique, Paris (France).

[NEUROPHYSIOLOGY OF APLYSIA GANGLION], by A. Arvanitaki-Chalazonitis and N. Chalazonitis. Final rept. Apr. 1, 1961-Mar. 31, 1962 [4]p (AFOSR-J1052) (AF EOAR-61-30) AD 420034 Unclassified

The studies have been performed on identifiable neurons of the nerve centers of Aplysia, either initially spontaneously active, or submitted to excitatory or inhibitory synaptic actions at various frequencies, impinging the center through different pathways. The individual activities of 2 to 4 cells were simultaneously recorded through 2 to 4 independent microelectrodes and dc amplifier channels. Emphasis was placed on the input-output relationships and on the bases underlying organization of spatio-thermal patterns of activity, basically implied in function and behavior.

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Century Geophysical Corp., Tulsa, Okla.

STUDY OF THE EARTH AS A SEISMIC ELECTRIC TRANSDUCER, by S. D. Buchanan. Semiannual technical summary rept. June 15, 1962, [21]p. incl. diagrs. tables. (AF 49(638)1085) AD 412484 Unclassified

Tests were conducted in 5 areas whose electroseismicity was known from work performed previously in conjunction with quarry tests. Tests consisted of shooting charges of one pound of dynamite or less at distances not in excess of 1,000 ft from the measuring site. Results obtained in the good E. S. areas were compared with those obtained in the bad E. S. areas. From this comparison a basis for measuring the electroseismicity of an area resulted. The electroseismicity of 14 Nevada test site areas was determined using the comparison criteria established above. Using the results obtained 2 areas were selected from which 2 nuclear blasts were measured. A series of controlled experiments was made in conjunction with small blasts of the order of one pound of dynamite. These experiments were performed at one of the better local E. S. areas and consisted of an evaluation of a 3-dimensional E. S. array. Electrode arrangements for these tests are shown. A self potential and resistivity log was made of one of the holes in order that the E. S. results might be correlated with local geology. Additional tests were made to determine the feasibility of a model study of the phenomenon. (Contractor's abstract)

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Century Geophysical Corp., Tulsa, Okla.

STUDY OF THE EARTH AS A SEISMIC ELECTRIC TRANSDUCER, by S. D. Buchanan, D. P Hearn and others. Final rept. Oct. 25, 1962 [80]p. incl. diagrs. tables, refs. (AF 49(638)1085) AD 298996 Unclassified

For quarry blasts of the type and size encountered in this investigation (600 to 13,000 pounds), a detection range of approximately 10 miles is indicated. Ripple firing of the quarry blasts considerably reduced the maximum distance at which the electroseismic signal produced by these blasts could be detected. There is extreme variability in the ability of different areas to produce an electroseismic signal. Creek bottoms, in general, were found to be more active as electroseismic transducers than hilltops or barren tableland. The inability to find active electroseismic areas near the GNOME blast or the Nevada Test Site precluded the possibility of making a determination of the true potential of the electroseismic technique as a tool for detecting nuclear blasts. However, it is felt that had suitable areas been found, a signal could have been recorded at both stations for the GNOME blast and at Location 7 in Nevada. A vertical electrode span was found to offer an improvement in S/N ratio of 15:1 over that for a surface electrode span. The maximum signal on a vertical electrode span occurred when the down hole electrode was at the sand-shale interface. For the model study, the electroseismic signal amplitude increased as the percent of sand in a sand-shale mixture was increased. The effect of changing the conductivity of the interstitial water on the amplitude of the electroseismic signal was found to be minimal.

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Chicago U. Committee on Mathematical Biology, Ill.

STUDIES IN MATHEMATICAL BIOPSYCHOLOGY, by H. D. Landahl and H. White. Final rept. Apr. 1, 1962, 29p. incl. diagrs. refs. (AFOSR-2451) (AF 49(638)-414) AD 287857 Unclassified

A brief report on a study of visual adaptation is given Principal results are a second order differential equation for the concentration of rhodopsin, a model that explains how the sensitivity of the rod depends on the concentration, a model that explains the shape of the b-wave of the electroretinogram, and the fitting of some data on illumination thresholds on the basis of these models. The problems of real and apparent movement are discussed in terms of simple neural nets. An expression is derived for maximum distances between stimuli for various time intervals and stimuli intensities. Results compare favorably with available data so preliminary results on the simplest possible mechanism give an output which depends on the velocity and the width of a sharply defined stimulus, there being a maximum with respect to velocity. Movement of a poorly defined stimulus, e.g., intensity $S = 0$ for $x < 0$, $S = x$ for $0 \leq x \leq A$, and S constant for $x > A$ gives an output proportional to the velocity of movement and to S, and independent of A. (Contractor's abstract, modified)

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Chicago U. Committee on Mathematical Biology, Ill.

ON VISUAL ADAPTATION: I. PHOTOCHEMISTRY, by H White. [1962] [9]p. incl. diagrs. refs. (AFOSR-J615) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)414 and Public Health Service) AD 404149; AD 414012 Unclassified

Also published in Bull. Math. Biophys., v. 24: 351-359 Dec. 1962.

Quantitative aspects of the photochemistry of visual adaptation are considered. A simplified model is given that fits data on changes of rhodopsin concentration during and following strong illumination. A variation on Wald's

compartment hypothesis is shown to fit the quasi-linear dependence of log threshold upon pigment concentration. Finally, there is a brief review of pertinent data on cone pigments. (Contractor's abstract)

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Chicago U. Committee on Mathematical Biology, Ill.

THE DERIVATION OF D'ARCY THOMPSON'S THEORY OF TRANSFORMATIONS FROM THE THEORY OF OPTIMAL DESIGN, by R. Rosen. [1962] [19]p. incl. diagrs. (AFOSR-2459) (AF 49(638)917) Unclassified

Also published in Bull. Math. Biophys., v. 24: 279-290, Sept. 1962.

It is shown informally that Cohn's theory of Optimal Forms can be construed as a comparative theory, and that when this is done, the celebrated theory of transformations of D'Arcy Thompson follows as a consequence. The implications of this type of theoretical foundation for the Thompson theory with regard to problems of comparative morphology are discussed, and some suggestions for the further implementation of the theory are described. (Contractor's abstract)

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Chicago U. Committee on Mathematical Biology, Ill.

CHURCH'S THESIS AND ITS RELATION TO THE CONCEPT OF REALIZABILITY IN BIOLOGY AND PHYSICS, by R. Rosen. [1962] [19]p. incl. refs. (AFOSR-3206) (AF 49(638)917) AD 400659 AD 403590 Unclassified

Also published in Bull. Math. Biophys., v. 24: 375-393, Dec. 1962.

An attempt to characterize the physical realizability of an abstract mapping process in terms of the Turing computability of an associated numerical function is described. Such an approach rests heavily on the validity of Church's thesis for physical systems capable of computing numerical functions. This means in effect that one must investigate in what manner Church's thesis can be converted into an assertion concerning the nonexistence of a certain class of physical processes (namely, those processes which are capable of calculating the values of numerical functions which are not Turing-computable). A formulation which may be plausible is suggested, and it is then shown that the truth of Church's thesis in this form is closely connected with the effectiveness of theoretical descriptions of physical systems. It is shown that the falsity of this form of Church's thesis is related to a fundamental incompleteness in the possibility of describing physical systems, much like the incompleteness which Gödel showed to be inherent in axiomatizations of elementary arithmetic. Various implications of these matters are briefly discussed. (Contractor's abstract)

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Chicago U. Dept. of Chemistry, Ill.

REACTIVE INTERMEDIATES IN CYCLOPROPANE CHEMISTRY, by W. G. Brown. Final rept. Dec. 31, 1962, 6p. incl. diagrs. (AFOSR-4875) (AF 49(638)784) AD 413469 Unclassified

Studies were made of the chemistry of 1,1-dimethyl-2,3-dinitrocyclopropane. Unlike the mono-nitro compound, the ring hydrogens are liable to acetate ion, – catalyzed hydrogen - deuterium exchange. With a stronger base, hydroxyl ion, the compound readily undergoes a ring cleavage similar to those known for nitrocyclopropyl ketones. Further studies were made on the photochemical transformations of aryl ketones containing cyclopropyl substituents, as well as analogous compounds with larger rings. The preliminary findings disclose patterns of photolytic reactions not hitherto exemplified. One example is the formation of 2-methyl-4-benzoyl-1-butene upon UV irradiation of 1-benzoyl-2,2-dimethylcyclopropane. (Contractor's abstract, modified)

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Chicago U. Dept. of Chemistry, Ill.

β,β-DIMETHYL-δ,δ-DIPHENYL-δ-VALEROLACTONE, by W. G. Brown and F. Greenberg. [1962] [1]p. [AF 49(638)784] Unclassified

Published in Jour. Org. Chem., v. 28: 599, Feb. 1963.

Stetter and Krause described the preparation of a compound believed to be 1,3-dibenzoyl-2,2-dimethylpropane by a Friedel-Crafts condensation of 3,3-dimethylglutaryl chloride (I) with C_6H_6. A repetition of this work showed that the product actually was β-β-dimethyl-δ-δ-diphenyl-δ-valerolactone(II). I(20.8g), treated with 29g of $AlCl_3$ in 150 ml C_6H_6 at 0°, the mixture stirred 2 hr at room temperature, and the product crystallized, gave 5.8g of II, which melted at 91.7-92.2°. The Grignard synthesis from 0.95g diethyl 3,3-dimethylglutarate (0.95g) gave 1.02g of II. Successive treatment of II with NH_2OH, HCl, and $FeCl_3$ gave the wine color for esters and lactones. Infrared and nuclear magnetic resonance spectra were given for II.

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Chicago U. [Dept. of Mathematics] Ill.

ON ONE-SIDED LOCALIZATION OF TRIGONOMETRIC SERIES, by A. Zygmund. [1962] [13]p. (AFOSR-J449) (AF 49(638)551) Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szegö, C. Loewner and others. Stanford U. Press, 1962, p. 435-447.

Let S be a trigonometric series $\sum c_n e^{inx}$ with coefficients c_n tending to 0 as $n \to \pm \infty$. The series S is

localizable at the point x_0 to the right if there is another trigonometric series T such that for some $\epsilon > 0$, (1) T is equiconvergent with S in the interior of $(x_0, x_0 + \epsilon)$; (2) T converges to 0 in the interior of $(x_0 - \epsilon, x_0)$. In this definition S is necessarily localizable at x_0 to the left. The main theorem is as follows. A necessary and sufficient condition for $S = \Sigma c_n e^{inx}$ to be localizable at x_0 is that the integrated series

$$S_1 = c_0 x + C_0 + \sum' (c_n / in) e^{inx} \text{ converges at } x_0,$$

and $\lim_{n \to \pm\infty} \sum_{|k| \le |n|/2} \frac{c_{n-k} \exp i(n+k)x_0}{k} = 0$

Some related theorems are also given. (Math. Rev. abstract)

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Chicago U [Dept. of Mathematics] Ill.

A CLASS OF DOUBLY TRANSITIVE PERMUTATION GROUPS, by M. Suzuki. [1962] [3]p. [AF 49(638)858] Unclassified

Published in Proc. Internat'l. Cong. of Mathematicians, Stockholm (Sweden) (Aug. 15-22, 1962) Djursholm, Institut Mittag-Leffler, 1963, p. 285-287.

The author discusses some recent work concerning the classification of certain classes of doubly transitive permutation groups. (Math. Rev. abstract)

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[Chicago U. Dept. of Mathematics, Ill.]

ON GENERALIZED (ZT)-GROUPS, by M. Suzuki. [1962] [4]p. [AF 49(638)858] Unclassified

Published in Arch. Math., v. 13: 199-202, 1962.

Doubly transitive permutation groups which satisfy the following conditions are studied: (1) the degree of G is $1 + n$ where n is a power of 2. (2) the subgroup H consisting of elements which leave one fixed symbol invariant contains a normal subgroup Q which is regular on the remaining n symbols; (3) the subgroup consisting of elements leaving 2 distinct symbols invariant is a cycle group of odd order. A class of groups satisfying conditions 1 - 3 can be constructed as follows: Let $\sigma(x, y) = x_1, y_1^q + x_2, y_2^q + x_3, y_3^q$ be the hermitian defined over GF (q^2), where q is a power of 2, the projective unitary group contains a normal simple subgroup of index 1 or 3 denoted by HO $(3, q^2)$. Then HO $(3, q^2)$ acts as a permutation group on the points $x = (x_1, x_2, x_3)$ in the projective plane with $\sigma(x, x) = 0$. It can then be verified that HO $(3, q^2)$ satisfies 1 - 3 with $n = q^3$. In addition, some groups of semilinear transformations over near fields of special character satisfy these same 3 conditions. The following theorem is proved: Let G be a doubly transitive permutation group satisfying conditions 1 - 3 Then G is one of the groups discussed above. (Math. Rev. abstr. .)

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[Chicago U. Dept. of Mathematics, Ill.]

ON THE STABILITY OF A MACLAURIN SPHEROID OF SMALL VISCOSITY, by P. H. Roberts and K. Stewartson. [1962] [14]p. incl. refs. (AFOSR-J865) (Sponsored jointly by Air Force [Office of Scientific Research] under AF AFOSR-62-136 and Army [Research Office (Durham)]) AD 415835 Unclassified

Also published in Astrophys Jour., v. 137: 777-790, Apr. 1, 1963.

The stability of a viscous Maclaurin spheroid is solved asymptotically for small kinematic viscosity, ν. It is shown that, in this limit, the frequency of oscillation, n, with respect to the mode which becomes neutrally stable in the absence of viscosity at the point of bifurcation (where the eccentricity, e, of the meridional section is approximately 0.8127), is

$$n = n_0 + i \frac{5\nu n_0^2}{a^2 Q(e)} + O(\nu).$$

In the foregoing formula n_0 denotes the frequency in the absence of viscosity, a is the radius of the equatorial section, and Q(e) is a certain function of e which changes sign at $e = 0.8127$ and is positive for smaller values of e. From equation (1) it follows that the Maclaurin spheroid is indeed unstable beyond the point of bifurcation when viscosity is present.

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[Chicago U. Dept. of Mathematics, Ill.]

ON HIGHLY ROTATING POLYTROPES. I, by P. H. Roberts [1962] [13]p. incl. diagrs. (AFOSR-1277) (AF AFOSR-62-136) AD 424346 Unclassified

Also published in Astrophys. Jour., v. 137: 1129-1141, May 15, 1963.

This paper is concerned with the equilibrium of a highly rotating mass of fluid which obeys a polytropic equation of state. Since exact solutions are possible only when the angular velocity Ω of the configuration is small compared with $(G\rho)^{1/2}$, where ρ is the mean density and G is the gravitational constant, the methods expounded in this paper are necessarily approximate. It is supposed that the equidensity surfaces are similar and similarly situated oblate spheroids, and the problem is reduced to finding the appropriate eccentricity of these spheroids and the variation of density with equatorial radius. Three methods of making these determinations are proposed and are examined in detail for the polytrope of index unity. These methods, respectively, depend on (1) a variational principle,

(2) satisfying hydrostatic equilibrium exactly in the equatorial plane, and (3) satisfying hydrostatic equilibrium exactly on the polar axis. Method 1 is shown to lead to results which are a compromise between those of methods 2 and 3. Some attention is given to the question of whether or not, as Ω is increased, the polytrope will bifurcate to a Jacobi form before equilibrium is broken by centrifugal forces at the equator. It is concluded that if the polytropic index is less than unity (approximately), bifurcation will indeed occur.

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Chicago U. [Dept. of Mathematics] Ill.

NOTE ON A NONLINEAR EIGENVALUE PROBLEM, by M. Shinbrot. [1962] [7]p. (AFOSR-J1622) (AF AFOSR-62-136) AD 429262 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 552-558, Aug. 1963.

The author considers the equation $\lambda u = Au + \lambda^{\alpha} B_{\lambda} u$ in a Hilbert space H where: (1) A is a compact symmetric operator with simple eigenvalues u_n. Its eigenfunctions v_n span H. Moreover, if $\delta_n = \min_{j \neq n} u_n - u_j$, then $\sum u_n^{\alpha} \delta_n^{2} < \infty$. Here $\alpha > 1$. (2) B_{λ} is an operator defined for all λ in the disk $\lambda \leq (\alpha \alpha - 1))^{1} A$. B_{λ} is uniformly bounded by "B" in that disk and satisfies a Lipschitz condition $B_{\lambda} - B_{\mu} \leq L' \lambda - u$. He proves the theorem: There exist infinitely many eigenvalues λ_n and eigenfunctions u_n of the above equation. The sequence $\{\lambda_n\}$ approaches zero. Moreover, there is an integer N such that $K_N \supset H_N$ and, if x is any element of H, it can be represented in the form

$$x = \sum_{1}^{N-1} \xi_n v_n + \sum_{N}^{\infty} \xi_n u_n.$$

Finally, if A and the series given in (1) above are small enough, N may be taken as unity, so that the sequence $\{u_n\}$ is complete in H. Here H_N denotes the subspace spanned by $\{v_N, v_{N-1}, \ldots\}$ and K_N denotes the subspace spanned by all but the first N - 1 of the eigenfunctions of the equation, if infinitely many such exist. In order to establish the series expansion of the theorem, an existence proof including many estimates is needed. Also needed here is a theorem of Paley and Wiener. An application is made to the equation

$$Lu = \frac{d}{dx} p \frac{du}{dx}.$$

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Chicago U. Dept. of Mathematics, Ill.

ON HIGHLY ROTATING POLYTROPES. II, by P. H. Roberts. [1962] [11]p. (AFOSR-64-0978) (AF AFOSR-62-136) AD 440152 Unclassified

Also published in Astrophys. Jour., v. 138: 809-819, Oct. 1, 1963.

In Part I (item no. 555, Vol. VI) a variational method was given for determining approximately the structure of a rotating polytrope. On specifying an n-parameter family of equidensity surfaces, the variational method gave the "best" values for these n-parameters and the "best" density to assign to each surface. In this paper a two-parameter family of surfaces, namely, oblate spheroids of variable eccentricity is assumed. The variational method is used to derive differential equations for the eccentricity e(m) and the density p(m), as a function of the equatorial radius m. It is proved that, for small e, the theory agrees with that of Clairaut and also with that of Chandrasekhar for a slightly distorted polytrope.

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Chicago U. Dept. of Physics, Ill.

COMPARISON OF LOCALIZED AND DELOCALIZED MODELS FOR n - π* STAR TRANSITIONS: A POSSIBLE INTERPRETATION OF THE OBSERVED SYM-TETRAZINE FLUORESCENCE, by M. A. El-Bayoumi and D. R. Kearns [1962] [2]p. (AFOSR-64-2335) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)923 and Atomic Energy Commission) AD 452018 Unclassified

Also published in Jour. Chem. Phys., v. 36: 2516-2517, May 1962.

The merits and failures of different theories of n - π* transitions in monocyclic azines are reviewed. A semiempirical theory is developed which accounts more successfully for most of the experimental observations.

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Chicago U. [Dept. of Physics] Ill.

QUASI-FREE PROTON-PROTON SCATTERING IN LIGHT NUCLEI AT 450 MEV, by H. Tyren, S. Kullander, and R. Ramachandran. Final rept. Oct. 15, 1962 [8]p. incl. diagrs. tables, refs. (AFOSR-4787) (AF 49(638)-958) AD 408559 Unclassified

Quasi-free proton-proton scattering in light nuclei has been studied experimentally at 450 mev incident proton energy. Energy and angular correlations of the 2 emerging protons have been measured using 2 double focusing magnetic spectrometers and a multi-channel electronic detector system. (Contractor's abstract)

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Chicago U. [Dept. of Psychology] Ill.

FREQUENCY DISCRIMINATION AFTER BILATERAL SECTION OF THE BRACHIUM OF THE INFERIOR COLLICULUS, by J. M. Goldberg and W. D. Neff. [1961] [26]p. incl. illus diagrs. tables, refs. (Sponsored

jointly by Air Force Office of Scientific Research under [AF 49(638 925] and Office of Naval Research]
Unclassified

Published in Jour. Compar. Neurol., v. 116: 265-280, 1961.

Nine cats were trained to make an auditory frequency discrimination. The brachium of the inferior colliculus was then sectioned bilaterally and after recovering from operation the animals were retrained. The cats could be divided into 3 groups: (1) evoked potential to click stimuli were recorded from auditory cortex at time of sacrifice and microscopic examination of the brain stem sections revealed that the brachium of the inferior colliculus was not completely sectioned; (2) evoked potentials were recorded from auditory cortex even though the brachium was completely sectioned; and (3) auditory cortex was not electrically responsive to click stimuli and the brachium was completely sectioned. It is concluded that animals in which the auditory system is completely sectioned at the level of the brachium of the inferior colliculus cannot relearn in 1000 trials the same frequency discrimination that animals in which the geniculo-cortical auditory system is eliminated by ablation of auditory cortex can relearn in less than 300 trials.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

COMPILATION OF HYPERFRAGMENT BINDING ENERGIES, by N. Crayton, R. Levi-Setti and others. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-1817) (In cooperation with Northwestern U., Evanston, Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)209, and National Science Foundation) AD 295884 Unclassified

Also published in Rev. Modern Phys., v. 34: 186-189, Apr. 1962.

The purpose of this work is to present new results on π^--mesonic decays of "heavy hypernuclei" ($A > 5$) and at the same time to report on an up-to-date compilation of binding-energy data for all hypernuclear species.

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Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

[NUCLEAR EMULSION STUDIES OF THE PROPERTIES OF HYPERNUCLEI] by R. Levi-Setti and V. L. Telegdi. Final rept. [1962] [12]p. incl. refs. (AFOSR-4298) (AF 49(638)209) AD 293985 Unclassified

Considerable information concerning the properties of hypernuclei has been determined. It has been established that the Λ-nucleon interaction is charge symmetric, namely the Λ-n interaction is essentially as strong as the Λ-p interaction. This conclusion is drawn from the study of the binding energy of mirror hypernuclei. Also established was the fact that the Λ-n interaction is spin dependent. This conclusion stems from both the analysis of the binding energies, and from the experimental determination of the spins of hypernuclei like $_{\Lambda}H^{3}$, $_{\Lambda}H^{4}$, and $_{\Lambda}Li^{8}$. The Λ-nucleon interaction is found to be stronger in the antiparallel orientation of the Λ and N spins, in contrast with the opposite situation for the nucleon-nucleon (N-N) interaction. It also became possible to estimate the depth D_{Λ} of the potential well experienced by a Λ hyperon in infinite nuclear matter from an analysis of the binding energy of very heavy hyperfragments — a value of [illegible] mev was found. The weak Λ-nucleon interaction was explored in studies of the decay modes and lifetimes of hypernuclei. Several new checks concerning the so-called $\Delta T = \frac{1}{2}$ rule have been supplied. The lifetime of $_{\Lambda}H^{4}$ was measured yielding a result which confirmed the spin assignment $J = 0$ for $_{\Lambda}H^{4}$. The slow Λ-N de-excitation processes $\Lambda + N \rightarrow N + N$, and $\Lambda + p \rightarrow N + p$ were investigated showing that these 2 processes occur with comparable frequency. Several properties bearing on the nuclear-physics aspects of hypernuclei were explored including phenomena of final state interaction as well as production processes of hyperfragments. It was also shown that (Σ^-n) hyperfragments do not exist. Finally, several improvements in measuring techniques are reported.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

A PROBABLE EXAMPLE OF THE DECAY $\Sigma^0 \rightarrow \Lambda + e^+ + e^-$ IN NUCLEAR EMULSION, by D. H. Davis, R. Levi-Setti and others. Feb. 1962, 8p. incl. illus. table, refs. (Rept. no. EFINS 62-7) (AFOSR-4423) (AF 49(638)209) AD 295966 Unclassified

Also published in Phys. Rev., v. 127: 605-606, July 15, 1962.

An event has been observed in nuclear emulsion which is attributed to the production of a Σ^0 hyperon and its subsequent decays via the mode $\Sigma^0 \rightarrow \Lambda + e^+ + e^-$. From the apparent concurrence of the tracks involved in the disintegrations, it has been deduced that the Σ^0 lifetime for this event is $< 10^{-14}$ sec.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

A DETERMINATION OF THE SPIN OF $_{\Lambda}Li^{8}$, by D. H. Davis, R. Levi-Setti, and M. Raymund. [1962] [5]p. incl. diagrs. table, refs. (AFOSR-65-0464) (AF 49-(638)209) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 469, Aug. 27, 1962.

Also published in Nuclear Phys., v. 41: 73-77, Feb. 1963.

The available data on ${}_{\Lambda}Li^{8} \rightarrow \pi^{-} + He^{4} + He^{4}$ decay have been analyzed in terms of intermediate Be^{8} states. Out of 41 events, 32 are interpreted as involving the 2^{+}, 2.9-mev level of Be^{8}, while the remainder seem to proceed through other Be^{8} states (including the ground state). The center-of-mass angular distribution of the two He^{4} nuclei (relative to the π direction) has been studied for the 32 decays to the 2^{+} state of Be^{8}. A comparison with the theoretical prediction of Dalitz indicates that the spin of ${}_{\Lambda}Li^{8}$ is most likely unity.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

HYPERFRAGMENT PRODUCTION BY 4.5 GEV/C π^{-}-MESON INTERACTIONS IN EMULSION NUCLEI. A REAPPRAISAL, by J. Zakrzewski, D. H. Davis, and O. Skjeggestad. [1962] [8]p. incl. diagrs. refs. (AFOSR 65-0836. (AF 49(638)209) AD 617872 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 652-659, Feb. 1, 1963.

The hyperfragment production by fast π^{-}-meson interactions is shown to be well explained by the model of Jones et al. In particular, the short-range hyperfragments are shown to be predominantly very heavy and not light as had been supposed. The conclusions of Silverstein, Fry et al and Lokanathan et al, are critically examined with recourse to this fact.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

BINDING ENERGY OF Λ^{0} HYPERONS IN HEAVY HYPERNUCLEI (60 < A < 100), by D. H. Davis, R. Levi-Setti and others. [1962] [3]p. incl. diagrs. table. (AFOSR-65-0837) (AF 49(638)209) AD 617044 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 464-466, Dec. 1, 1962.

From a study of the total visible energy release in the non-mesonic decays of Λ-hypernuclei in emulsion, which are the spallation products of silver and bromine with masses in the range A = 80 to A = 100, an upper limit of about 35 mev is placed on the value of the binding energy B. From the observation of 5 π^{-} mesonic decays, which are attributed to hyperfragments of the same order of mass, a more precise estimation of this limit is made, namely, about 25 mev. These fragments resulted from the interactions of K^{-} mesons of 800 mev/c and 1.5 gev/c. At 800 mev/c 3 examples of mesonic decay were accompanied by about 1100 non-mesonic disintegrations.

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Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

BINDING ENERGIES OF HEAVY HYPERNUCLEI, by N. Crayton, D. H. Davis and others. [1962] [3]p. incl. diagr. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)209] and National Science Foundation) Unclassified

Published in Proc. 1962 Internat'l. Conf. on High-Energy Physics, at CERN, Geneva (Switzerland) (July 4-11, 1962), Geneva, CERN, Scientific Information Service, 1962, p. 382-384.

The binding energies and decay modes of the identified heavy hyperfragments from 56 π^{-}-mesonic decays of hypernuclei with a mass greater than 5 are tabulated. A compilation of present data averaged with previously published data is also presented.

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Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

DETERMINATION OF THE ${}_{\Lambda}H^{4}$ LIFETIME, by N. Crayton, D. H. Davis and others. [1962] [3]p. incl. illus. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)209] and National Science Foundation) Unclassified

Published in Proc. 1962 Internat'l. Conf. on High-Energy Physics at CERN, Geneva (Switzerland) (July 4-11 1962), Geneva, CERN, Scientific Information Service, 1962, p. 460-462.

The ${}_{\Lambda}H^{4}$ lifetime was measured by observation of both decays at rest and in flight by the mode ${}_{\Lambda}H^{4} \rightarrow He^{4} + \pi^{-}$. In an emulsion stack exposed to a stopping K^{-} beam, 9 decays in flight and 43 decays at rest were found. From these the maximum likelihood estimate of the ${}_{\Lambda}H^{4}$ mean lifetime was determined to be $(1.18\ {}^{+0.65}_{-0.30}) \times 10^{-10}$ sec.

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Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

HYPERNUCLEI, by V. L. Telegdi. [1962] [7]p. incl. diagrs. table. [AF 49(638)209] Unclassified

Published in Scient. Amer., v. 206: 50-56, Jan. 1962.

An historical review of hypernuclei is presented. Various hyperons and their properties are given in table form.

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Chicago U. [Enrico Fermi Inst. for Nuclear Studies] I.I.

MESIC DECAYS OF HYPERNUCLEI FROM K^- INTERACTIONS AT REST AND AT ~ 800 Mev c (Abstract) by N. Crayton, D. H. Davis and others. [1962] [1]p. (In cooperation with Northwestern U., Evanston, Ill.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)209] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer Phys Soc., Series II, v. 7 49, Jan. 24, 1962.

Two emulsion stacks have been exposed to the 800 mev c separated K^- beam at the Bevatron. Both stacks are built up of ~ 1.2 mm thick K-5 pellicles. Stack 1 consists of 82 such pellicles of area 4 in. x 6 in. and contains ~ 6×10^4 stopping K^-. Stack 2 consists of 117 pellicles of area 6 in. x 8 in. and was exposed to ~ 10^6 K^- incident at ~800 mev/c. To date ~ 400 mesic hyperfragments (MHF) have been found in stack 1 and ~ 100 MHF in stack 2. Measurements on these events are now in progress, and preliminary results will be presented. In particular a comparison of MHF production by K^- at rest and in flight will be attempted. In addition data will be presented bearing on the binding energy (B_Λ) for those hypernuclei where B_Λ is rather poorly known, as well as on rare decay modes of hyperfragments. If sufficient data are available by then, an estimate will also be given for the lifetime of the Λ bound in nuclear matter.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill

HIGH ENERGY ELECTRONS OF SOLAR ORIGIN, by P. Meyer and R. Vogt. Apr. 1962 [8]p. incl. diagrs. (AFOSR-2970) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1008, National Aeronautics and Space Administration, and National Science Foundation) Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 387-389. May 1962.

The existence of electrons in the primary cosmic radiation has been established over the past yr. The question, whether these electrons have their origin in the galaxy, within the solar system, or both, has remained open. Attempts were made to investigate whether electrons in the energy range from 100 mev to several bev may be emitted by the sun during solar flares which are known to produce protons of similar energy. An observation is reported here which shows that electrons may be emitted by the sun during a solar flare and that the active region, which passed center meridian on July 14, 1961 did indeed emit electrons with energies about 100 mev which could be observed at the earth.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

PRIMARY COSMIC RAY AND SOLAR PROTONS II by P. Meyer and R. Vogt. [1962] [5]p. incl. diagrs. table, refs. (AFOSR-J461) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-23, National Aeronautics and Space Administration, National Science Foundation, and Office of Naval Research; and Royal Canadian Air Force) AD 407 ..
Unclassified

Also published in Phys. Rev., v. 129: 2275-2279, Mar. 1, 1963.

During July and Aug. 1961, the energy spectrum of primary cosmic-ray protons was investigated in the energy range from 80 to 350 mev. The observations were made in 5 high-altitude balloon flights at geomagnetic latitudes $\lambda \geq 73$ N. Solar flare and quiet day spectra were obtained. A comparison of the 1960 and 1961 results leads to the following conclusions: (1) A significant flux of low-energy protons is continually present in the primary radiation in the years of high solar activity. (2) This flux decreases with the declining level of solar activity as the galactic cosmic-ray flux increases. It is, therefore, suggested that it is of solar origin. (3) The time dependence of the observed proton flux suggests the following alternatives: (a) the particles are produced or released more or less continuously by the sun and do not originate only in the large flare events; or (b) the particles are produced in individual large solar flares and subsequently stored over long periods of time. This second alternative would require a new and as yet unknown storage mechanism with a characteristic time of about 30 or more days. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE PHYSICAL SIGNIFICANCE AND APPLICATION OF L, B_0, AND R_0 TO GEOMAGNETICALLY TRAPPED PARTICLES, by E. C. Stone [1962] [10]p. incl. diagrs. (AFOSR-J1552) (AF AFOSR-62-23) AD 427408
Unclassified

Also published in Jour. Geophys. Research, v. 68: 4157-4166, July 15, 1963.

In a dipole field, many different invariant shells (L, B_m) share exactly the same lines of force. These invariant shells are therefore members of a degenerate system. In the geomagnetic field, which is assumed static and without electric field, these degenerate systems are split by azimuthal asymmetry. A distinction is made, therefore, between the use of parameters as invariants of charged particle motion (invariant representation) and their use as constants for all particles on a line of force (degenerate representation). It is found that McIlwain's L value associates nondegenerate geomagnetic shells with dipole degenerate systems if L at a point in space is redefined to apply only to particles mirroring at that point. Emphasis is placed on the redefined L as an invariant parameter of particle motion

and on the near equality of the L value of a particle and the equatorial radius R_0 of the line of force on which the particle is mirroring. Although the original definition of L resulted in a very useful parameter, the present definition allows a physical interpretation of L as originally applied and extends its usefulness beyond that allowed by the original definition. With the present definition, the different values of L along a line of force can be identified with the radial separation of particles mirroring on that line as they drift in longitude. This separation is $\approx 2\bar{\epsilon}$ of the shell radius and represents the accuracy with which a single magnetic field parameter, such as the minimum field intensity B_0 of a line, describes all particles on the line (a degenerate representation). Beyond 3 earth radii, it is found that R_0 gives a representation of comparable accuracy. However, an invariant representation (L, B_m) or (I, B_m) is limited only by the accuracy of the determination of the mirror field B_m and the longitudinal invariant I, both of which depend on the accuracy of the magnetic field representation. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

LOADING OF EMULSIONS STACKS WITH AQUEOUS SOLUTIONS OF LITHIUM ACETATE, by D. H. Davis, R. Levi-Setti and others. [1962] [13]p. incl. illus. diagrs. tables. (AFOSR-64-0510) [AF AFOSR-62-358] AD 436375 Unclassified

Also published in Nuovo Cimento, Series X, Suppl. no. 3, v. 26: 345-357, 1962

It is shown that thick pellicles can be loaded with lithium acetate solutions still maintaining all the desirable geometrical and physical properties of normal emulsion. Aside from the main purpose of the method, that of introducing lithium atoms in the emulsion the loaded pellicles offer a number of interesting properties which may be helpful in various applications. Loading with lithium acetate increases appreciably the relative content of light elements in the emulsion. Experiments in which water loading was previously required can be carried out with the advantage of a better track image, using these emulsions. The production of hyperfragments from K^- capture stars will be undoubtedly enhanced, while the decreased stopping power (with respect to normal emulsions) may prove useful in lifetime studies. Additional advantages arise from the fact that pellicles originally 1200 μ m. This may serve to increase the density of tracks by almost a factor of 2, of some value in the presence of beams of low intensity. The effort in tracing long tracks through the stack is reduced and the efficiency in detecting connected events in a single pellicle is correspondingly increased.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

BINDING ENERGIES OF HYPERNUCLEI WITH MASS NUMBER A ~ 5, by N. Crayton, D. H. Davis and others. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0810) (In cooperation with Northwestern U., Evanston, Ill.) (AF AFOSR-62-358) AD 6[illegible]5036 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 1078-1086, Mar. 1, 1963.

Results are presented on the binding energies of hypernuclei of mass number A ~ 5. The data from 56 π^--decays of such hypernuclei are combined with the previously existing data. Problems in the identification of the heavier hypernuclei are critically discussed. The possible existence of an isomeric state of $^7He_\Lambda$ is considered.

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Chicago U. Inst. for the Study of Metals, Ill.

EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE ELECTRONIC PROPERTIES OF GERMANIUM SEMICONDUCTORS AT HELIUM TEMPERATURES, by H. Fritzsche. Final technical rept. Feb. 20, 1962, 14p. incl. refs. (AFOSR-2277) (AF 49(638)802) AD 283261 Unclassified

Germanium semiconductors were prepared by transmutation-doping. In this method, pure Ge or Ge containing a known impurity concentration is irradiated with slow neutrons. Ge^{70} and Ge^{74} capture these neutrons and transmute into Ga^{71} and As^{75}, respectively, in a ratio which depends on the isotropic abundances and capture cross sections. The advantages are: the compensation ratio is accurately known; one can prepare series of samples in which either the compensation ratio is held constant and the impurity concentration varies, or the minority impurity concentration is fixed and the majority impurity concentration is varied, or the majority impurity concentration is fixed and the minority impurity concentration is varied; and the samples are homogeneous.

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Chicago U. Inst. for the Study of Metals, Ill.

MOBILITY OF IONS IN LIQUID He^4 I AND He^3 AS A FUNCTION OF PRESSURE AND TEMPERATURE, by L. Meyer, H. T. Davis and others. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-1777) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52 and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 126: 1927-1934, June 15, 1962.

An experimental study is presented of the pressure and temperature dependence of the mobility of the positive and negative species of charged particles in liquid He^4 above the λ transition and in liquid He^3. The mobility of the positive species in He^4 decreases linearly with increasing density, and the Stokes radius of the positive species is inversely proportional to $T^{\frac{1}{2}}$. The mobility of the negative species initially increases with

increasing density and then falls off linearly with further increase in density. The Stokes radius of the negative species increases with increasing temperature. At constant density the mobilities of both species in He^4 and He^3 vary very slowly with temperature. At the vapor pressure and around 2.2°K there is a larger temperature dependence than indicated above, but this is probably due to the approach of the λ transition. The mobility of the positive species in He^4 and He^3 at 3.0°K is a linear function of density, independent of the isotope. (Contractor's abstract, modified)

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Chicago U. [Inst. for the Study of Metals] Ill.

KINETIC THEORY OF DENSE FLUIDS. XII. ELECTRONIC AND IONIC MOTION IN LIQUID He^4 I AND LIQUID He^3, by H. T. Davis, S. A. Rice, and L. Meyer. [1962] [7]p. incl. tables, refs. (AFOSR 375, (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52, National Science Foundation, Petroleum Research Fund of the American Chemical Society, and Public Health Service) Unclassified

Also published in Jour. Chem. Phys., v. 37: 1521-1527, Oct. 1, 1962.

The mobilities of positive and negative charge carriers in liquid He^3 and He^4I are calculated and the resultant agreement with experiment is excellent. The negative carrier is taken to be an electron. Due to electrostriction and density fluctuations the effective mass of the electron is of the order of 100 electron masses. In addition, the disorder of the liquid leads to incoherences in the scattering of the electron from atomic pseudopotentials. The positive carrier is taken to be He_2^+. An extension of the theory of Rice and Allnatt leads to a formula for the mobility in terms of a quantum-mechanical temperature. Electrostriction increases the density about an ion and the dissipation arises about equally from the short-range repulsive forces and the Coulomb and van der Waals attractive forces. Both calculations involve only basic considerations and there are no adjustable parameters in the theory. The computed effective mass of the negative carrier in He^3 at 3.00°K and 2-atm pressure is 105 electron masses: The observed effective mass is 97 electron masses. For the negative carrier in He^4I at 4.2°K and 1-atm pressure the computed and observed effective masses are 149 and 128 electron masses, respectively. In the case of the positive ion, the observed mobility at 2.2°K and 1-atm pressure in He^4 is $5.6 \times 10^{-2} cm^2 V^{-1} sec^{-1}$ while the computed value is $5.2 \times 10^{-2} cm^2 V^{-1} sec^{-1}$. (Contractor's abstract, modified)

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Chicago U. Inst. for the Study of Metals, Ill.

EXCITON-EXCITON INTERACTIONS AND PHOTOCONDUCTIVITY IN CRYSTALLINE ANTHRACENE. by S. Choi and S. A. Rice. [1962] [8]p. incl. diagr. table, refs. (AFOSR-J376) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52, National Science Foundation, and Public Health Service) Unclassified

Also published in Jour. Chem. Phys., v. 38: 366-373, Jan. 15, 1963. (AFOSR-64-2183; AD 452415)

In this paper the mechanism of photoconductivity in crystalline anthracene is considered. It is shown that 2 excitons may interact to form a pair of charge carriers and an unexcited molecule. The computed rate of generation of charge carriers is 3.7×10^8 cm^{-3} sec^{-1}, in satisfactory agreement with the (approximate) experimental value of 7.2×10^8 cm^{-3} sec^{-1} when the exciton concentration is 1.2×10^{10} cm^{-3}. Other qualitative features of the proposed mechanism are in agreement with observation if electron-hole recombination is accounted for. Recent experiments by Silver demonstrating a photocurrent proportional to the square of the light intensity, and by McGlynn demonstrating the necessity for singlet states as the kinetic intermediate in charge-carrier generation are in agreement with the model proposed. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

EXCITON-EXCITON INTERACTIONS AND PHOTOCONDUCTIVITY IN ORGANIC CRYSTAL, by S. Choi and S. A. Rice. [1962] [3]p. (AFOSR-J377) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52 and National Science Foundation) Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 410-412, May 15, 1962.

Northrop and Simpson (Proc. Roy. Soc. (London), v. 244A: 377-389, Mar. 25, 1958) suggest that photoconductivity in doped anthracene may be due to exciton-exciton interaction. This possibility is investigated by considering the properties of a lattice of hydrogen atoms, in which it is found that there is a finite probability of transfer of exciton energy between degenerate states. It is suggested that in the case of an organic crystal this process may be even more likely.

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. XIII. THE MOBILITY OF NEGATIVE IONS IN LIQUID Ar, Kr, Xe, by H. T. Davis, S. A. Rice, and L Meyer. [1962] [3]p. incl. diagrs. tables. (AFOSR-J378) (AF AFOSR-61-52) Unclassified

Also published in Jour. Chem. Phys., v. 37: 2470-2472, Nov. 15, 1962.

Measurements are reported of negative ion mobilities in liquid Ar, Kr, and Xe, and a comparison of the observations with the modern statistical theory of transport is given. It is tentatively suggested that the negative ion involved in these studies is O_2^-. Accepting this premise, quantitative agreement between theory and experiment is attained if the depth of the non-Coulomb portion of the potential well of the O_2^--Ar interaction is a factor 3.4 greater than the depth of the O_2-Ar potential well. Uncertainties in the calculation of the pair correlation function prevent confirmation of all details of the theory. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF SIMPLE DENSE FLUIDS. XI. EXPERIMENTAL AND THEORETICAL STUDIES OF POSITIVE ION MOBILITY IN LIQUID Ar, Kr, AND Xe, by H. T. Davis, S. A. Rice, and L. Meyer. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-J37-9) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52, National Science Foundation, and Petroleum Research Fund of the American Chemical Society) Unclassified

Also published in Jour. Chem. Phys., v. 37: 947-956, Sept. 1, 1962.

Measurement of the mobility of positive ions in liquid Ar, Kr, and Xe at various temperatures and pressures is reported. The magnitude, the pressure dependence, and the temperature dependence of the positive ion mobility in liquid Ar, Kr, and Xe can be quantitatively accounted for by an extension of the theory of Rice and Allnatt. It is found that negative contributions to the momentum autocorrelation function are of dominant importance. Modification of the simple Nernst-Einstein relationship between the charge mobility and the self-diffusion constant of the parent atom by inclusion of the effects of polarization leads to quantitative agreement between theory and experiment. The effect of the long range Coulomb potential is to increase the local density about the ion and thereby to increase the frictional forces arising from the short range interaction potential. The rate of dissipation of energy directly by the long-range Coulomb potential is small compared to the rate of energy dissipation by the short range potential. Agreement between experiment and theory is very satisfactory if the positive ion is Ar_2^+, Kr_2^+, or Xe_2^+ and it is suggested that this is the ionic species present. Agreement is much poorer if a different ionic species is postulated. If the ions are regarded as probes to alter and study the liquid structure it can be deduced that the current theory of liquids seriously miscalculates the change in the equilibrium pair correlation as a function of temperature and pressure. It is believed that the error arises from either a premature truncation of a slowly convergent series used in the solution to an integral equation, or at worst, that the assumed series expansion is invalid. (Contractor's abstract, modified)

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Chicago U. Inst. for the Study of Metals, Ill.

EXCITON-EXCITON INTERACTIONS AND PHOTOCONDUCTIVITY IN CRYSTALLINE ANTHRACENE, by S. Choi and S. A. Rice. [1962] [8]p. incl. diagr. table, refs. (AFOSR-64-2183) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52, National Science Foundation, and Public Health Service) Unclassified

Also published in Jour. Chem. Phys., v. 38: 366-373, Jan. 15, 1963.

For abstract see item no. 579, Vol. VI.

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Chicago U. [Inst. for the Study of Metals] Ill.

IONS AS PROBES INTO QUANTUM FLUIDS, by L. Meyer, S. A. Rice, and H. T. Davis. [1962] [3]p. incl. diagr. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-52], National Science Foundation, and Public Health Service) Unclassified

Also published in Proc. Eighth Internat'l. Conf. on Low Temperature Phys., London (Gt. Brit.) (Sept. 16-22, 1962), Washington, D. C., Butterworths, 1963. p. 53-55.

Measurements of the mobilities of positive and negative ions in liquid He^3 at temperatures between 1° and 3°K, and pressures between 1 and 3 atm are reported. Using the Stokes formula for the mobility of a sphere the authors deduced the radius of the positive ion to be 5A at 3.2°K, and that of the negative ion to be 14A at 3.2°K and 9A at 1.2°K. To interpret these results the positive ion is assumed to be He_2^+ and the negative ion to be an electron. A theory is outlined which treats the positive ions by a semiclassical friction-constant-method and the negative ions by considering scattering by long-wavelength-density fluctuations and using an effective mass estimated from polaron theory.

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE THERMODYNAMIC PROPERTIES OF SOLUTIONS OF POLARPOLYMERS. A COMPARISON OF EXPERIMENT AND THEORY, by R. Corneliussen, S. A. Rice, and H. Yamakawa. [1962] [11]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-52], Atomic Energy Commission, and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 38: 1768-1778, Apr. 1, 1963.

A comparison of experimental and theoretical studies of the thermodynamic properties of solutions of polar

polymers is presented: (a) A new method of achieving isopiestic equilibrium is described in detail. (b) The excess free energies of solutions of toluene with poly-p-methylstyrene, poly-p-bromostyrene and several copolymers of p-methyl and p-bromostyrene are reported and analyzed. (c) The continuum model of concentrated solutions of polar polymers presented in the following paper is shown to be accurate for $\phi_1 > 0.4$, for the polymers studied. (d) The perturbation theory of dilute solutions of polar polymers presented in the following paper shown to predict the proper behavior in the limit of zero polymer concentration. (e) The properties of copolymers with small skeletal concentration of polar subunits is shown to agree with the predictions of the perturbation theory presented in the following paper. (f) The fundamental assumption of the continuum theory concerning the relationship between dipolar orientation and chain connectivity is examined and shown to agree with experiment. (g) Deviations between theory and experiment are briefly discussed in terms of the basic assumptions of the model, and methods by which the theory can be improved are described. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE THERMODYNAMIC PROPERTIES OF SOLUTIONS OF POLAR POLYMERS. THEORY, by H. Yamakawa, S. A. Rice and others. [1962] [9]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-52], Atomic Energy Commission, and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 38: 1759-1767, Apr. 1, 1963.

A simple analysis of the thermodynamic properties of solutions of polar polymers is presented. It is found that: (a) In the dilute solution regime, a cluster analysis identical with that used in the theory of solutions of nonpolar polymers can be developed, but with the thermodynamic parameter z now dependent on the dipole moment, dielectric constant, etc. (b) In the concentrated solution regime, a continuum theory can be developed based on the assumption of uniform mixing of polymer chains and the use of cavity field and reaction field arguments. (c) For dilute solutions of a polar polymer in a nonpolar solvent, or a nonpolarizable polar polymer in a polar solvent, the system is equivalent to an ordinary nonpolar polymer-poor solvent system. (d) It is generally true that the solvent becomes poorer as the dipole moment and or polarizability of the segment are increased. Also, the solvent becomes better as its dielectric constant increases. (e) In the case of concentrated solutions of a polar polymer in a nonpolar solvent, the polar contribution to the Flory-Huggins free-energy parameter, χ_p, decreases with increasing concentration. (f) In the case of concentrated solutions of a nonpolar polymer in a polar solvent, χ_p increases with increasing concentration. (g) The dilute solution theory and concentrated solution theory predict the same functional form for χ_p in the limit of zero polymer concentration, but the numerical coefficients differ. (h) The results of extensive digital computer calculations are presented in terms of the predicted concentration dependence of χ_p with varying properties of both polymer and solvent. Agreement between theory and experiment is examined in detail in the preceding paper. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

THEORY OF ELECTRONIC AND IONIC MOBILITY IN LIQUID He^4I AND LIQUID He^3, by H. T. Davis, S. A. Rice, and L. Meyer. [1962] [3]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-52], National Science Foundation, and Public Health Service) Unclassified

Published in Phys. Rev. Ltrs., v. 9: 81-83. Aug. 1, 1962.

A theoretical derivation of electronic and ionic (He_2^+) mobility in liquids He^4I and He^3 is given. For the former it is assumed that: (1) the electron polarizes its surroundings and this state of the medium follows its motion causing thereby an increase in its effective mass, (2) the quasi-free electron is scattered from the atoms of the surrounding fluid, the coherence of scattering being determined by the distribution of the atomic centers. In the ionic case the mobility expression is obtained by the derivation of the results on the transport phenomena of Rice and Allnatt (Jour. Chem. Phys., v. 34: 2144, 1961) using the procedure of Mazo and Kirkwood for quantum fluids (Proc. Nat'l. Acad. Sci., v. 41: 205, 1955).

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Chicago U. Inst. for the Study of Metals, Ill.

INTRA- AND INTERVALLEY SCATTERING AND THE TAILING OF THE CONDUCTION BAND IN IMPURE N-TYPE GERMANIUM, by H. Fritzsche and M. Cuevas. [1962] [6]p. (AFOSR-3569) [AF AFOSR-62-178] AD 612234 Unclassified

Also published in Proc. Internat'l. Conf on the Physics of Semiconductors, Exeter (Gt. Brit.), July 1962, p. 29-34.

The piezoresistance of degenerate n-type germanium doped with arsenic has been measured at 1.3°K using uniaxial compression along (110) and (111). The largest stress was 5×10^9 dyn/sq cm. The results are compared with a simple degenerate model which includes intra- and intervalley scattering but which neglects the possibility of tail states. An appreciable contribution to intervalley scattering was found. The mobility due to intravalley scattering appears to be independent of impurity concentration between 8×10^{17} and 5×10^{18} cm^3. (Contractor's abstract)

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Chicago U Inst. for the Study of Metals, Ill.

HALL COEFFICIENTS OF LIQUID METALS, by A. J. Greenfield. [1962] [2]p. incl. diagr. table. (AFOSR-J574) [AF AFOSR-62-178] AD 415204 Unclassified

Also published in Phys. Ltrs., v. 3: 121-122, Dec. 15, 1962.

An experimental technique having an error a factor of 4 less than that of previous work has been developed for measurement of the Hall coefficients, R, of liquid metals. Results obtained on Hg, In, Tl, and Pb are reported in the present note. For Hg and In, the measured Hall coefficient is equal to the free electron value, i.e., the value obtained from an electron concentration equal to the atomic concentration times the valency 2 for Hg and 3 for In. For Tl and Pb, however, the measured Hall coefficients are about 18% and 32% smaller than the respective free electron values corresponding to a valency of 3 for Tl and 4 for Pb.

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Chicago U. Inst. for the Study of Metals, Ill.

EFFECT OF ELASTIC STRAIN ON INTERBAND TUNNELING IN Sb-DOPED GERMANIUM, by H Fritzsche and J. J. Tiemann. [1962] [10]p. incl. diagrs. table, refs. (AFOSR-J892) (AF AFOSR-62-178) AD 416536 Unclassified

Also published in Phys. Rev., v. 129: 617-626, Apr. 15, 1963.

The effects of uniaxial compression and of hydrostatic pressure on the direct and indirect tunneling processes in germanium tunnel diodes have been studied experimentally under forward and reverse bias at 4.2 K and compared with Kane's theory. The diodes were formed by alloying indium doped with 3.8% gallium on (100) and (110) faces of germanium bars containing an antimony concentration of 5.5×10^{18} cm^{-3}. The first order change of the tunneling current with stress was measured at fixed bias voltages. For biases smaller than 8 mv the current is direct and not affected by the relative shifts of the (111) conduction band valleys. In the bias range of indirect tunneling the anisotropic tunneling from the (111) valleys was observed in agreement with theory. In the range of direct tunneling to the (000) conduction band the current change is correlated with the stress induced change of the direct band gap and of the energy separation between the (111) and (000) conduction bands. This separation was found to be 0.160 ± 0.005 ev at zero stress in agreement with optical measurements on degenerate germanium. Some details of the bias dependence of the pressure effect including some fine structure at small biases remain unexplained.

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Chicago U. Inst. for the Study of Metals, Ill.

SELF-DIFFUSION OF PALLADIUM IN SILVER-PALLADIUM ALLOYS, by R. L. Rowland and N. H. Nachtrieb. [1962] [21]p. incl. diagrs. table, refs. (AFOSR-5171) (AF AFOSR-62-231) AD 416440 Unclassified

Also published in Jour. Phys. Chem., v. 67: 2817-2831, Dec 1963.

The self-diffusion coefficient of Pd is reported for 850° and 996° in a series of silver-palladium solid solutions in which the atom fraction of palladium ranges from 0 to 0.204. For each temperature the data may be represented by an equation of the form $D_{Pd} = D_{Pd}0 \exp(bX)$, where X is the atom fraction of Pd and b = -7.5. Alternatively, the results conform to the equation $D_{Pd} = 0.0165 \exp(-17.21\ T_m\ T)$, indicating that a corresponding states law is followed in this nearly ideal system. (Contractor's abstract)

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Chicago U. Lab. for Applied Science, Ill.

EXPERIMENTAL INVESTIGATIONS OF TRANSPORT PROPERTIES OF PARTIALLY IONIZED GASES, by P. J. Dickerman. Final rept., Feb. 15, 1961-Feb. 15, 1962. Mar. 1962, 59p. incl. illus. diagrs. tables, refs. (Rept. no. LAS-TR-207-2) (AFOSR-2432) (AF 49(638)-1033) Unclassified

Recent advances in electric arc research and development allow stable high-temperature environments to be obtained over extended periods of time in the laboratory. By making use of the known relationships between temperature and conductivity in such arc discharges and by experimentally measuring the current density, electron density, and temperature, the effective cross section of atoms which impede the electron flow can be determined. Thus, atom-electron collision cross sections can now be measured in the interesting energy range of 1 to 2 ev, lower than heretofore possible using conventional beam apparatus. Techniques involved in making the necessary spectroscopic and electrical measurements are given, and results obtained for 3 gases (argon, helium, and nitrogen) are presented. These results are then used to determine several of the transport properties for these partially ionized gases. (Contractor's abstract)

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Chicago U. Lab for Applied Sciences, Ill.

SPECTRAL LINE SHAPES AND TRANSITION PROBABILITIES FOR ARGON, by P. J. Dickerman and B. P. Aliptner. [1962] [3]p. incl. diagr. table. (AFOSR-4278) [AF AFOSR-62-269] Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 305-307, July Sept. 1962.

A dip in the emission profile of each of 5 strong atomic argon lines (6500A–9000A) excited in the plasma of a high pressure arc in argon is discussed in terms of possible self-absorption even though the lower levels of the transitions are at ~ 11 ev. The effect is not present in the profiles of 8 weaker lines.

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Chicago U. Lab. for Applied Sciences, Ill.

FLUORESCENCE SPECTRA AND LIFETIMES OF SOME RARE-EARTH COMPOUNDS, by F. F. Rieke and R. Allison. [1962] [2]p. incl. diagr. table. (AFOSR-J506) (AF AFOSR-62-292) AD 407874 Unclassified

Also published in Jour. Chem. Phys., v. 37: 3011-3012, Dec. 15, 1962.

Measurements of the fluorescence lifetimes of $TbAn_3$ and EuD_3 were made at 25°C, 0°C, and 77°K. The same measurements were made on chlorides of europium and terbium at 25°C and 77°K only. The fluorescence lifetime at 25°C for the chelated rare-earth compounds is found to be more than twice the respective chloride lifetimes; for EuD_3, 529 μsec, for $TbAn_3$, 1067 μsec. The measurements at 0°C and 77°K showed that the fluorescence lifetime for $TbAn_3$ increased slightly, while that for EuD_3 remained unchanged.

595

Chicago U. Lab. of Molecular Structure and Spectra, Ill.

[QUANTUM MECHANICAL CALCULATIONS ON ATOMS AND MOLECULES] by C. C. J. Roothaan. Final technical rept. Apr. 1, 1961-Mar. 31, 1962, 3p. (AFOSR-4029) (AF 49(638)1068) AD 290666 Unclassified

Techniques for performing quantum mechanical calculations on atoms and molecules were developed. A number of calculations on actual atomic and molecular systems were carried out. Important achievements were in (1) atomic self-consistent field calculations; (2) calculations on linear 3- and 4-center molecules; (3) computer programs for diatomic molecules; and (4) one-center expansion for polyatomic molecules.

596

Chicago U. Lab. of Molecular Structure and Spectra, Ill.

ONE-CENTER EXPANSION SELF-CONSISTENT FIELD MOLECULAR ORBITAL ELECTRONIC WAVE FUNCTIONS OF XH_n MOLECULES, by R. Moccia. [1962] [2]p. incl. tables. (AFOSR-4030) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)1068, National Academy of Sciences, and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 37: 910-911, Aug. 15, 1962.

To investigate the potentiality of the one-center expansion method, calculations were made using a general purpose computer program. Computations on the following molecules in their ground states were made: CH_4, NH_3, NH_4^+, H_2O, HO^-, HF, SiH_4, PH_3, PH_4^+, H_2S, HS^-, and HCl. The equilibrium configuration was established in each case and results are presented in table form. Details of the wave function for the calculated equilibrium of H_2O, as a typical example, are also reported.

597

Chicago U. Lab. of Molecular Structure and Spectra, Ill.

ACCURATE ANALYTICAL SELF-CONSISTENT FIELD FUNCTIONS FOR ATOMS. II. LOWEST CONFIGURATIONS OF THE NEUTRAL FIRST ROW ATOMS, by E. Clementi, C. C. J. Roothaan, and M. Yoshimine [1962] [3]p. incl. tables. (AFOSR-4039) (AF 49(638)1068) Unclassified

Also published in Phys. Rev., v. 127: 1618-1620, Sept. 1, 1962.

Self-consistent field wavefunctions have been obtained for the ground states of the first row atoms and for the excited states belonging to the same configurations. They are the solution of the variational problem of finding the best orbitals for a given state, without any additional approximations except for those inherent in the expansion method. (Contractor's abstract)

598

Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

ATOMIC SELF-CONSISTENT FIELD CALCULATIONS BY THE EXPANSION METHOD, by C. C. J. Roothaan and P. S. Bagus. [1962] [59]p. incl. tables, refs. (AFOSR-4040) (AF 49(638)1068) AD 290668 Unclassified

The expansion technique is extended to a class of atomic states which may have one open shell for each symmetry species. The equations which are derived then are the answer to the question of finding the determinant (or sometimes sum of determinants) of lowest total energy, under the constraint that this total wave function has the appropriate symmetry and spin properties. A computer program, written for the IBM 7090, and based on the expansion method, is described. The following topics are discussed: general theory, calculation of integrals, eigenvectors and eigenvalues, SCF iterations and extrapolations, convergence control, exponent variation, output format and options, input format and conventions, and limitations of the program.

599

Chile U., Santiago.

ANATOMICAL BASIS OF PATTERN RECOGNITION, by H. R. Maturana. Final rept. [1962] 6p. (AFOSR-5250) [AF AFOSR-61-44] AD 416510 Unclassified

Work on the visual system of the pigeon is summarized. The classes of retinal cells are defined by the description of the optimal stimulus configuration to which the cells respond. The cells of each class, however show some variability with respect to the size of the response and its microstructure. The size of the response depends in general on the direction and intensity of contrast and the speed of movement. That the various classes of cells are retinal is shown by the fact that it is possible to register their activity from a cut optic nerve. It is only in relation to the verticality detectors that proof cannot be offered. Color vision experiments indicated that in mammals both form and color vision are mediated by the same elements which project to the lateral geniculate body, and from there to the cerebral cortex. In birds and amphibians they are separated. Form vision is mediated by cells that project to the tectum, while color vision appears mediated by cells that project to the diencephalon at a nucleus homologous to the lateral geniculate body.

600

Chile U., Santiago.

UNIDIRECTIONAL RESPONSE TO ANGULAR ACCELERATION RECORDED FROM THE MIDDLE CRISTAL NERVE IN THE STATOCYST OF OCTOPUS VULGARIS, by H. R. Maturana and S. Sperling. [1962] [2]p. incl. illus. (AFOSR-J842) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-44], National Science Foundation, and Office of Naval Research) AD 416520 Unclassified

Also published in Nature, v. 197: 815-816, Feb. 23, 1963.

In these experiments, recordings were made from the left statocyst of 13 animals, and more than 60 units, isolated or in groups, were studied. The results indicated 2 main facts: (1) That the same unit responds to 2 modes of stimulation, namely, to low-frequency vibration and to angular acceleration. These differences in response pattern could be used for their central distinction. A similar duality of response is found in statocyst receptors of crustaceans. (2) That there is no resting activity and that the response to angular acceleration is unidirectional. Whether this unidirectionality is due to a mechanical property of the statocyst, the cupula or the hair cells, or to the interaction of the latter with local neurones, is not yet known, but this property and the absence of resting activity make this system different from the known equilibrium systems of vertebrates and crustaceans.

601

Chile U., Santiago.

FUNCTIONAL ORGANIZATION OF THE PIGEON RETINA, by H. R. Maturana. [1962] [9]p. incl. diagrs. (AFOSR-65-1963) (AF AFOSR-61-44) AD 626389 Unclassified

Also published in Proc. Internat'l. Union of Physiological Sciences; Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962). Amsterdam, Excerpta Medica Foundation, v. 3: 170-178, 1962.

The response of the retinal ganglion cells of pigeons is studied when stimulated by specific visual configurations rather than luminous points. The cells are found to be grouped into 6 classes: verticality detectors, horizontality detectors, general edge detectors, directional moving edge detectors, convex edge detectors, and luminosity detectors. The first 5 do not respond to luminous stimuli in most cases but only to an adequate visual configuration. The retinal ganglion cells of the pigeon are compared to those of the cat and it is thought that they represent 2 types of visual systems: (1) a deterministic system in amphibians, reptiles and birds in which the function of the ganglion cells is highly specialized and unambiguous; and (2) an indeterministic system in mammals in which the function is unsepcific and ambiguous. It is also suggested that complex cell functions are not achieved by simple algebraic summation of excitatory and inhibitory processes, but that these processes play a role of components in the configuration of afferent impulses.

602

Chile U., Santiago.

ELECTROENCEPHALOGRAM IN THE PERMANENTLY ISOLATED FOREBRAIN OF THE CAT, by J. Villablanca. [1962] [3]p. incl. illus. refs. (AFOSR-J312) (AF AFOSR-62-392) AD 408054 Unclassified

Also published in Science, v. 138: 44-46, Oct. 5, 1962.

The cerebral cortex of cats with chronic or permanent mesencephalic transections of the brain stem showed both high-voltage, slow-wave synchronized electroencephalographic patterns and low-voltage, fast-wave desynchronized rhythms when studied postoperatively. The alternation of sleep and wakefulness electrical activity in the permanently isolated forebrain is contrasted with the observations of Bremer in the acute 'cerveau isole' preparation. (Contractor's abstract)

603

Chile U., Santiago.

CONDITIONED DEFENSIVE MOTOR REFLEXES IN CATS. ELECTROENCEPHALOGRAPHIC, ELECTROCARDIOGRAPHIC AND RESPIRATORY CONCOMITANTS (Abstract), by G. Santibanez-H. [1962] [1]p. [AF AFOSR-62-393] Unclassified

Published in Proc. Internat'l. Union of Physiological Sciences; Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 2: Abstract no. 1182, 1962.

Observations were made of the motor, respiratory and cardiac reactions and of the cortical and subcortical electroencephalographic responses. The association between an indifferent stimulus and a discharge in the paw was used to indicate conditioned excitatory activity. Two inhibitory conditioned reflexes were established.

one of differentiation and one of conditioned inhibition. Before regeneration, there was generally no cardiac or respiratory response. Evoked potentials always occurred in the reticular formation, hippocampus and cortex when the animal focused its attention on the stimulus. The discharge in the paw produced defense movements, an increase in heart rate and a decrease in respiratory rate and amplitude. After regeneration most of the cats passively awaited the electric shock and the conditional stimulus produced bradycardia and hypopnoea. In the case of conditioned inhibitory reflexes, differentiation could be established perfectly from the cardio-respiratory point of view. On the other hand, in spite of the many sessions gone through with some animals, it was not possible to establish conditioned inhibition.

604

Cincinnati U. Dept. of Chemistry, Ohio.

EXCHANGE REACTIONS IN GROUP II ORGANOMETALLIC SYSTEMS, by R. E. Dessy, F. Kaplan and others. [1962] [3]p. incl. tables, refs. (AFOSR-J1153) (AF 49(638)824) AD 423127 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1191-1193, Apr. 20, 1963.

Exchange reactions in dialkylmetal-dialkylmetal systems (R_2M and R'_2M') involving organometallic compounds derived from group II metals have been investigated. Exchange is rapid except when mercury is one of the metals. A pathway involving the transfer of one group at a time from the metal giving rise to unsymmetrical species RMR' and $RM'R'$ must be present.

605

Clarkson Coll. of Tech. [Dept. of Physics] Potsdam, N. Y.

EFFECT OF QUENCHING ON THE ELECTRICAL RESISTIVITY OF A β-BRASS SINGLE CRYSTAL, by M. C. Martin. [1962] [2]p. incl. diagr. table. (AFOSR-J890) (AF AFOSR-62-254) AD 415996 Unclassified

Also published in Jour. Appl. Phys., v. 34: 1835-1836, June 1963.

A sharp peak in room temperature resistivity was obtained when quenching β-brass from the region of the critical temperature. It is suggested that this is due to quenched-in disorder.

606

Colorado School of Mines Research Foundation, Inc., Golden.

GEOLOGICAL AND THERMODYNAMIC ASPECTS OF LUNAR ROCKS, by P. C. Badgley, F. C. Jaffe and others. July 1962. 86p. incl. illus. refs. (AFOSR DRA-62-11) (AF 29(600)2878) AD 287886 Unclassified

Geological and thermodynamic aspects of lunar rocks are studied. Several basic problems of lunar geology are examined with the main purpose of assembling the regional information needed to establish a list of possible lunar mineral deposits and to postulate on the origin of the Moon with emphasis on probable composion. Important problems related to the structural pattern of the Moon are discussed. A special study is devoted to the Vredefort Ring structure (South Africa), which has been recently interpreted as a convincing example of asteroidal impacts on the Earth. The distribution of craterlets is analyzed by statistical methods, in order to establish whether these typical lunar features are originated by volcanic activity or impact phenomena. The thermodynamic aspects are an attempt to provide a broad reconnaissance of the stability of rock-forming mineral oxides with respect to pressure and temperature. (Contractor's abstract)

607

Colorado State U. Dept. of Mathematics and Statistics, Fort Collins.

STURM-LIOUVILLE SYSTEMS THAT GENERATE FAMILIES, by F. M. Stein. [1962] [8]p. (AFOSR-64-1322) [AF AFOSR-62-219] AD 444138 Unclassified

Also published in SIAM Rev., v. 6: 12-19, Jan. 1964.

A family of Sturm-Liouville boundary-value problems is defined to be the collection of all Sturm-Liouville boundary-value problems which can be obtained from a given one by repeatedly differentiating or integrating the differential equation space and applying the given boundary conditions. The author gives a necessary and sufficient condition that a Sturm-Liouville problem generates a family. He also shows that the derivatives of the eigenfunctions of a Sturm-Liouville problem, which generates a family, are orthogonal with respect to a weight function which can be calculated explicitly. (Math. Rev. abstract)

608

Colorado State U. [Dept. of Mathematics and Statistics] Fort Collins.

A TCHEBYCHEFF TYPE INEQUALITY FOR GAMMA, by T. L. Connell and F. A. Graybill. [1962] 9p. incl. diagr. [AF AFOSR-62-220] Unclassified

An attempt is made to find an inequality that is an improvement of Tchebycheff's inequality for a random variable that is distributed as gamma with parameters r and λ. This necessitates showing that

$$\int_{1-a}^{1+a} f_1(v)\,dv > 1-e^{-a\sqrt{n-1}},$$

for all $a > 0$ and $n \geq 1$, where $f_1(\cdot)$ is the density of a chi-square divided by n, its degree of freedom. Tchebycheff's inequality is $P[|v-1| \geq a] \geq 1-2/a^2n$, the "improved" inequality established in this paper is $P[|v-1| \geq a] \geq 1-e^{-a\sqrt{n-1}}/\sqrt{e}$.

609

Colorado State U. [Dept. of Mathematics and Statistics] Fort Collins.

SAMPLE SIZE REQUIRED TO ESTIMATE THE RATIO OF VARIANCES WITH BOUNDED RELATIVE ERROR, by F. A. Graybill and T. L. Connell. [1962] [4]p. incl. table. (AFOSR-64-1641) [AF AFOSR-63-469] AD 446874 Unclassified

Also published in Jour. Amer. Stat. Assoc., v. 59: 1044-1047, Dec. 1963.

This concerns an estimate of the ratio of variances of 2 independent normal populations. The estimator deviates from the true ratio by less than a given proportion p of the ratio, with a prescribed probability. The purpose of this paper is to present a table that can be used to determine the sample size required to meet these specifications for values of p = .2, .25, .33, .4, .5, .6, .75, 1.0, 1.5, 2.0 and for probability levels 1-a-.90, .95, .99. (Contractor's abstract)

610

Colorado U. Dept. of Chemistry, Boulder.

BIREFRINGENCE IN A STRAINED VISCOELASTIC FLUID UNDER STEADY-STATE ROTARY CONDITIONS. II, by S. J. Gill and F. R. Dintzis. [1962] [12]p. incl. diagrs. (AFOSR-1148) (AF 49(638)310) AD 441850 Unclassified

Also published in Jour. Polymer Sci., v. 57: 251-262, 1962

A rotary strain device for introducing a calculable amount of strain into a viscoelastic fluid under essentially zero flow conditions has been built and tested. The principle of the device is based upon the continuous deformation of a flexible Teflon tube which is rotated within a closely fitting, stationary, rigid metal tube that has an elliptical cross section. A polymer solution placed in such a rotating tube is subjected to an alternating strain and rotation of the bulk material. Under such conditions a steady-state situation occurs where the material has well defined anisotropic properties. This anisotropic state is characterized by measuring both the retardation and orientation of the principle axes of the induced birefringence. Measurements made on fluid systems at rotations of approximately 50-200 rpm yield experimental results that agree with theoretical requirements. Mooney has analyzed the analogous situation of a microscopic rotating region. This analysis, when applied to measurements made in the rotary strain device, permits calculation of functions proportional to the storage modulus, the loss modulus, and the relaxation function of the polymer. Measurements and calculations are presented for carboxymethyl cellulose solutions in water. (Contractor's abstract)

611

Colorado U. Dept. of Chemistry, Boulder.

STRAIN BIREFRINGENCE OF A SOLUTION OF ROD-SHAPED MOLECULES, by S. J. Gill and F. R. Dintzis. [1962] [4]p. incl. diagrs. table, refs. (AFOSR-2149) (AF 49(638)310) AD 295967 Unclassified

Presented in part at 141st Nat'l. meeting of the Amer. Chem. Soc., Washington, D. C., Mar. 1962.

Also published in Jour. Phys. Chem., v. 66: 2046-2049, Oct. 1962.

A theoretical calculation is made for birefringence induced in a system of rod-shaped molecules which have been subjected to a 2 dimensional strain of constant area. A series expression is developed for the orientation of a system of rods which have the particular optical and geometrical properties of the strained system; then the birefringence of this system is given by an expression developed from assumptions of Peterlin and Stuart. This expression is used in conjunction with birefringence measurements to obtain the optical factor, $g_1 - g_2$, for concentrated solutions of poly-γ-benzyl-l-glutamate in 1, 2-dichloroethane. An average optical factor of $(5.4 \pm 1.0) \times 10^{-3}$ was obtained for these solutions; this compares with a value of about $(4.0 \pm 0.1) \times 10^{-3}$ obtained from flow birefringence measurements (by Doty) and electric birefringence (by O'Konski) on dilute solutions. (Contractor's abstract)

612

Colorado U. Dept. of Chemistry, Boulder.

VISCOELASTIC PROPERTIES OF POLYMER SOLUTIONS AND GELS, by S. J. Gill. Final rept. Mar. 1, 1958-Feb. 23, 1962. Mar. 1, 1962, 1v. incl. illus. diagrs. tables, refs. (AFOSR-2301) (AF 49(638)310) Unclassified

A summary of investigations on the physical properties of concentrated polymer solutions is given. These materials in a highly viscous to near gel state provide the concentration bridge between solid forms and very dilute solutions. A number of experimental devices which enable the exploration of the correlation between concentration, temperature and polymer structure are described.

613

Colorado U. Dept. of Chemistry, Boulder.

THEORETICAL CALCULATIONS OF STRESS RELAXATION IN CONCENTRATED SOLUTIONS, by R. Toggenburger, K. Beck, and S. J. Gill. [1962] [9]p. incl. diagrs. refs. (AFOSR-J661) (AF 49(638)310) AD 414924 Unclassified

Also published in Jour. Polymer Sci., Part A, v. 1: 1779-1787, May 1963.

The Mooney theory for stress relaxation of polymer materials has been numerically evaluated in unmodified and modified forms. The modified expressions include such effects as molecular weight distributions and entanglement or polymer interaction distributions. The relaxation behavior was found to be highly dependent upon the number of interaction points per chain molecule particularly for small numbers. The distributions in molecular sizes and in the number of interaction points have a much smaller effect on the shapes of the relaxation curves. A comparison of the theoretical stress relaxation behavior is made with birefringence relaxation data. The region of correlation indicates a number of 5 interaction points per molecule of polystyrene at 10 wt% in benzene.

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Colorado U. Dept. of Chemistry, Boulder.

ANISOTROPIC PROPERTIES OF STRAINED VISCOELASTIC FLUIDS. III. BIREFRINGENCE OF POLYSTYRENE SOLUTIONS, by R. Toggenburger and S. J. Gill. [1962] [14]p. incl. diagrs. tables, refs. (AFOSR-J662) (AF 49(638)319) AD 415175 Unclassified

Also published in Jour. Polymer Sci., Part A, v. 1: 1765-1778, May 1963.

Birefringence relaxation has been studied in concentrated polystyrene solutions. The birefringent state is induced by a sudden application of strains and the subsequent relaxation effect is observed by photoelectric monitoring. The effect of temperature concentration on the decay of induced birefringence follows the general patterns observed for stress relaxation. Samples of different molecular weights and different molecular weight distributions have been studied. A particularly simple empirical result was found to express the relaxation behavior of highly fractionated materials. In such instances the birefringence decays with exponential dependence upon the square root of time. The results for samples with broad distributions show curvature when plotted in a similar fashion. This simple relaxation behavior has a simple LaPlace transform, so that a comparison of the exact relaxation distribution function with approximate methods can be made. The general behavior of birefringence relaxation distribution functions is similar to that noted for stress relaxation functions. The method of reduced variables likewise is applicable to bring the birefringence relaxation results into correspondence at different temperatures.

615

Colorado U. Dept. of Chemistry, Boulder.

BRIDGED POLYCYCLIC COMPOUNDS. XIX. SOME ADDITION AND SOLVOLYSIS REACTIONS IN NORBORNANE SYSTEMS, by S. J. Cristol, W. K. Seifert and others. [1962] [8]p. incl. diagrs. table. (AFOSR-4353) (AF AFOSR-62-79) AD 295872 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 3915-3925, Oct. 20, 1962.

Acid-catalyzed additions of acetic acid, formic acid and water to endo-dihydrodicyclopentadiene lead to products in which almost complete ring isomerizations have occurred. On the other hand, addition of methanol (or of water in methanol solvent) to dicyclopentadiene, followed by hydrogenation, gives a mixture containing about 1 part of endo skeleton unrearranged product to 6 parts of exo skeleton product. Solvolysis of the toluenesulfonates in methanol both give a large preponderance of exo product. Addition of methanol or of acetic acid to norbornadiene gives substantially more dehydronorbornyl methyl ether, or dehydronorbornyl acetate in the mixture with nortricyclyl products than solvolysis of the p-bromobenzenesulfonate. Possible explanations of these results are discussed. (Contractor's abstract)

616

Colorado U. Dept. of Chemistry, Boulder.

BRIDGED POLYCYCLIC COMPOUNDS. XXI. THE IONIC CHLORINATION OF 9,10-DIHYDRO-9,10-ETHENOANTHRACENE, by S. J. Cristol, R. P. Arganbright, and D. D. Tanner. [1962] [4]p. incl. refs. (AFOSR-J722) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-79 and National Science Foundation) AD 414100 Unclassified

Also published in Jour. Org. Chem., v. 28: 1374-1377, May 1963.

The ionic chlorination of 9,10-dihydro-9,10-ethenoanthracene was shown to yield exo- and endo-4-syn-8-dichlorodibenzobicyclo[3.2.1]octadiene as the sole reaction products. The less stable of these isomers was the preponderant product. The structure proofs of these addition-rearrangement reaction products and some of their chemistry are discussed

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Colorado U. Dept. of Chemistry, Boulder.

BRIDGED POLYCYCLIC COMPOUNDS. XX. THE CIS-STEREOCHEMISTRY OF THE ADDITION OF METHANOL AND WATER TO ENDO-TRIMETHYLENE-NORBORNENE, by S. J. Cristol, L. K. Gaston, and D. W. Johnson. [1962] [5]p. incl. diagr. (AFOSR-J723) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-79 and National Science Foundation) AD 414097 Unclassified

Also published in Tetrahedron Ltrs., No. 4: 185-189, Feb. 1963.

Sulfuric acid-catalyzed additions of methanol (or of water in methanol) to the isomeric endo- and exo-trimethylenenorbornenes give differing ratios of endo- and exo-ring skeleton ethers (or alcohols). It is now shown that reactions with the isomeric endo-trimethylenenorbornenes are entirely cis-exo additions. The expected products resulting from the endo-protonated π complex reacting directly with a solvent molecule or by the equivalent of trans ring opening (by addition of CH_3OD

and D_2O), as well as noninvolvement in the reaction sequence are discussed. Attempts to distinguish these products are made by gas phase chromatography and nuclear magnetic resonance spectral studies. These results show clearly that cis-exo addition of both the H and Y (OCH_3, OH, OTs, $OCOC_6H_4NO_2$) portions of the addenda occurs, and exclude the endo-protonated π complex as a significant intermediate in the addition reaction. It is suggested that at least one of the intermediates involved is a classical ion, or that a cis addition 4-center transition state is involved, in which no carbonium ion is developed.

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Colorado U. Dept. of Physics, Boulder.

NUCLEAR RESONANCE OF Al IN SYNTHETIC RUBY, by W. H. Tanttila. Final rept June 1962 9p. incl. refs. (AFOSR-2768) (AF 49(638)611) AD 278429 Unclassified

Initial studies on the nuclear magnetic resonance of Al in ruby are summarized. LiCl containing Mn ion impurities was prepared. Nuclear resonance studies were performed on the Li at room temperature, liquid N and liquid He temperature. Electron paramagnetic resonance studies were performed at room temperature on the Mn ions. The Mn appeared to exist in the crystal in 2 phases, dilute and concentrated. In the dilute phase the Mn ion concentration in the host LiCl was 0.2 mol-%; in the concentrated phase the Mn ion concentration was 10%. LiF with Mn ion impurity was also prepared. The microwave spectrum indicated that up to concentrations of 10 mol-% of Mn there is no tendency of the Mn ions to form 2 phases or to precipitate separately from the LiF; there was no measurable diffusion of ions at room temperature. Other experiments included a search for an electric hexadecapole moment in In and Sb. (Contractor's abstract)

619

Colorado U. Dept. of Physics, Boulder.

NUCLEAR MAGNETIC DIPOLE MOMENT OF Ca^{41}, by E. Brun, J. J. Kraushaar and others. [1962] [2]p. (AFOSR-4574) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)611 and Atomic Energy Commission) AD 400844 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 166-167, Aug. 15, 1962.

The nuclear magnetic dipole spin resonance of Ca^{41} was observed in a saturated aqueous solution of $Ca(NO_3)_2$, using a Varian crossed-coil, c.w. spectrometer. The observed ratio of the Ca^{41} resonance frequency to that of the deuteron in the same field was $\nu(Ca^{41})/\nu(D^2) = 0.530631 \pm 0.000003$, implying an uncorrected nuclear dipole moment of -1.59235 ± 0.00002 nm for Ca^{41}, using the values of $\mu(H^1)/\mu(D^2) = 3.257199 \pm 0.0000012$ and $\mu(H^1) = 2.79268 \pm 0.00003$ nm. Taking into account diamagnetic shielding of the nucleus by orbital electrons, $(\mu(Ca^{41}) = -1.5946$ nm. The value obtained is discussed in the light of the de-Shalit mechanism.

620

Colorado U. [Dept. of Physics] Boulder.

ELECTRICALLY INDUCED $\Delta M = \pm 2$ NUCLEAR SPIN TRANSITIONS IN A GaAs SINGLE CRYSTAL (Abstract), by E. Brun, W. L. Pierce, and W. H. Tanttila. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)611] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 482, Aug. 27, 1962.

Direct electrical induction of $\Delta M = \pm 2$ nuclear quadrupole spin transitions in a GaAs crystal has been previously reported. A fairly detailed investigation using pulsed NMR techniques has now been made of these transitions for the isotopes Ga^{69}, Ga^{71}, and As^{75} in a high-resistivity single crystal of GaAs as a function of the relative orientations of the crystalline symmetry axes, the oscillating electric field, and the static magnetic field. It is found that a very simple theoretical model assuming a 1-parameter 3-rank tensor to describe the interaction of the crystal with the applied electric field, is capable of explaining the symmetry properties of the observed phenomena well, and the parameter which determines the components of this interaction tensor has been measured.

621

Colorado U. [Dept. of Physics] Boulder.

NMR AND EPR STUDIES IN LiCl (Abstract), by D. A. Jennings and W. H. Tanttila. [1962] [1]p. [AF 49(638)-611] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 84, Jan. 24, 1962.

The linewidth of the Li nuclear magnetic resonance in LiCl powder doped with Mn^{++} have been measured at 300°, 77°, and 4°K. The nominal Mn^{++} ion concentration ranged from 10^{-4} to 10^{-1}. Assuming a Gaussian shape for the experimental absorption, the experimental second moments are compared with the second moments calculated from Van Vleck's theory. Deviations from the predicted dependence of the second moment on the Mn^{++} concentration are found at low temperatures and high concentration. The electron paramagnetic resonance line structure of the Mn^{++} ion shows that the Mn^{++}

ions are present in a crystal in 2 widely different concentrations. The nuclear resonance linewidths will be explained in terms of a model that gives a consistent interpretation of the Mn^{++} ion linewidth.

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Colorado U. [Dept. of Physics] Boulder.

NUCLEAR SPIN LATTICE RELAXATION IN LiCl (Abstract), by G. Arnold, D. A. Jennings and others. [1962] [1]p. [AF 49(638)611] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 85, Jan. 24, 1962.

The Li nuclear spin lattice relaxation times have been measured in LiCl as a function of temperature and Mn^{++} ion concentration. Samples were prepared by rapidly quenching melted mixtures of LiCl and $MnCl_2$. Immediate examination of the Mn^{++} x-band spectra at x-band frequencies provide a check on the relative concentration of Mn^{++} going into the mixture and gives a qualitative indication of their distribution within the LiCl lattice. Pulsed nuclear induction techniques were used to measure the relaxation at 4°, 77°, and 300°K in samples containing up to 10% Mn^{++} concentration. The nuclear spin lattice relaxation is sensitive to the dispersion of impurities within the lattice. Diffusion of the Mn^{++} occurs with sample aging and causes large changes in the Li spin lattice relaxation time. In addition to studying the nuclear spin lattice relaxation process, the measurements also provide insight into the various phases of the LiCl-$MnCl_2$ system.

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Colorado U. [Dept. of Physics] Boulder.

PHONON-INDUCED NUCLEAR SPIN TRANSITIONS IN SOME INTERMETALLIC COMPOUNDS (Abstract), by A. B. Denison and H. P. Mahon, Jr. [1962] [1]p. [AF 49-(638)611] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 482-483, Aug. 27, 1962.

Phonon excitation of $\Delta m = \pm 2$ nuclear spin transitions is studied in crystals of GaAs and InSb. Phonons are introduced by a 15 mc/sec transducer. Using pulsed nuclear-induction techniques at 7.5 mc/sec, the line width $\Delta\nu$ is obtained at constant transducer voltage V and T_1 is obtained from signal recovery with time after ultrasonic saturation. This latter method overcomes spurious effects due to skin depth. M/M_0 vs V^2 (phonon intensity) is interpreted using a point-charge lattice model. The phonon-induced transition probability is $W = FQ^2\nu_1^2GV^2/\Delta\nu$. Q is the quadrupole moment, F a spin-dependent factor, and G is a number dependent upon lattice parameters and is the same for all nuclear species in each crystal. ν_1 is the Van Kranendonk charge-multiplication factor for the 1st-order process. A theory which would satisfactorily describe ionic, covalent, and charge-overlap phenomena in these crystals should give this value of ν_1. The ratios of the ν_1 for the nuclear constituents in these crystals are $\nu(Ga^{69})/\nu(As^{75}) = 0.42$ and $\nu(In^{115})/\nu(Sb^{121}) = 0.96$. This ratio for the gallium isotopes is, within experimental error, equal to one.

624

Colorado U. Dept. of Physics, Boulder.

PARAMAGNETIC RESONANCE OF Mn^{2+} IN LiF, by T. T. Chang and W. H. Tantilla. [1962] [2]p. incl. diagr. (AFOSR-J267) (AF AFOSR-62-345) AD 400986 Unclassified

The paramagnetic resonance of Mn^{2+} ion impurity in LiF at room temperature was studied. The low-temperature nuclear spin resonance in the Li and F in these crystals was also studied. Some of the data can only be explained on the basis of a certain amount of antiferromagnetism which increases as the concentration of Mn^{2+} is increased.

625

Colorado U. Dept. of Physics, Boulder.

ELECTRICALLY INDUCED NUCLEAR QUADRUPOLE SPIN TRANSITIONS IN A GaAs SINGLE CRYSTAL, by E. Brun, R. J. Mahler and others. [1962] [6]p. incl. diagrs. refs. (AFOSR-J593) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-345 and National Science Foundation) AD 414135 Unclassified

Also published in Phys. Rev., v. 129: 1965-1970, Mar. 1, 1963.

The direct induction of nuclear E2 spin transitions in a gallium arsenide single crystal by application of an external oscillatory electric field has been previously reported by some of the authors. This paper gives the results of a further investigation of the same phenomenon. Theoretical expressions are given for the equilibrium nuclear magnetization in a crystalline lattice under the combined influence of a static magnetic field, externally induced electric field gradients, and thermal spin-lattices interactions, for various relative orientations of the applied fields and the crystalline symmetry axes. The theoretical predictions were tested for the 3 nuclides Ga^{69}, Ga^{71}, and As^{75} by using pulsed nuclear magnetic resonance techniques to sample the equilibrium magnetization in a GaAs crystal at 77°K under the influence of a uniform, externally applied, radio-frequency, electric field. A description of the experimental apparatus is given. The dependence of the quadrupolar saturation on both the electric field amplitude and the crystal

orientation was measured. The angular dependence of the saturation was found to be in reasonable agreement with the theory. (Contractor's abstract)

626

Colorado U. Dept. of Physics, Boulder.

CROSSING SYMMETRY IN S-MATRIX THEORY, by A. O. Barut. [1962] [4]p. (AFOSR-J1260) (AF AFOSR-63-30) AD 424313 Unclassified

Also published in Phys. Rev., v. 130: 436-439, Apr. 1, 1963.

A general method is given to calculate the crossing relations for arbitrary processes which is based on the transformation properties of the amplitudes and analytic continuation only. The helicity amplitudes as well as the so called R and M amplitudes are considered and some simple examples are worked out.

627

Colorado U. Dept. of Physics, Boulder.

AMPLITUDES AND CROSSING RELATIONS IN ISOSPIN, by A. O. Barut and B. C. Unal. [1962] [6]p. (AFOSR-J1438) (AF AFOSR-63-30) AD 427712 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 112-117, Apr. 1, 1963.

A systematic group-theoretical method is used to determine the isotopic spin amplitudes and crossing relations for processes involving particles with arbitrary isotopic spins. For 2-body reactions, the scalar amplitudes and the crossing matrices are explicitly given up to I = 3/2. (Contractor's abstract)

628

Colorado U. Dept. of Physics, Boulder.

ON THE SYMMETRY OF ELEMENTARY PARTICLES-II, by A. O. Barut. [1962] [3]p. incl. diagrs. (AFOSR-J1439) (AF AFOSR-63-30) AD 427717 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 1269-1271, Mar. 1, 1963.

The elementary particles can be arranged in a hexagonal structure such that there are planes of constant charge, of constant baryon number, and of constant hypercharge. The resonant states σ, ω^0, N^+, Y_1 and Y_0 are similarly arranged in this paper and room is found to exist for 6 intermediate bosons and for particle analogous to the photon, but none for the ζ-particle.

629

Columbia U., New York.

COMPUTER TECHNIQUE FOR HIGH-SPEED EXTRACTION OF SPEECH PARAMETERS, by M. R. Weiss and C. M. Harris. [1962] [8]p. incl. illus. diagrs. table. [AF AFOSR-62-251] Unclassified

Presented in part at Speech Communication Seminar, Stockholm (Sweden), Aug. 1962.

Published in Jour. Acoust. Soc. Amer., v. 35: 207-214, Feb. 1963.

An automatic system is described for high-speed extraction of speech parameters. Data obtained from a high-resolution, real-time spectrum analyzer of the correlation type are converted to digital format and processed by a large-scale computer. An effective program has been written in FORTRAN and FAP languages for the extraction of spectrum power, amplitudes and frequencies of the first 3 formants and other functions of these parameters. Typical output data are presented. (Contractor's abstract)

630

Columbia U., New York.

PITCH EXTRACTION BY COMPUTER PROCESSING OF HIGH-RESOLUTION FOURIER ANALYSIS DATA, by C. M. Harris and M. R. Weiss. [1962] [5]p. incl. illus. diagrs. [AF AFOSR-62-251] Unclassified

Published in Jour. Acoust. Soc. Amer., v. 35: 339-343, Mar. 1963.

A method of automatic pitch extraction is described, and examples are shown of results obtained. The speech signals are processed by a real-time Fourier analyzer whose output is converted to digital form and recorded on tape for processing by an IBM 7090 computer. The logic of the computer program, written in FORTRAN language, is described together with a discussion of the accuracy of the over-all pitch-extraction system. (Contractor's abstract)

631

Columbia U. Columbia Radiation Lab., New York.

INFRARED AND OPTICAL MASERS, by P. Kusch. Final rept. Oct. 16, 1958-Nov. 30, 1961. Mar. 6, 1962, 10p. (AFOSR-2412) (AF 49(638)507) Unclassified

The research performed during the tenure of this contract is discussed. The work has been for the most part concerned with the construction and operation of an alkali-vapor optical maser and a ruby optical maser. Results of the research, including a list of the publications emanating from this work are presented.

632

Columbia U. Columbia Radiation Lab., New York.

OPTICAL DOUBLE-PHOTON ABSORPTION IN CESIUM VAPOR (Abstract), by I. D. Abella and C. H. Townes. [1962] [1]p. [AF 49(638)507] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys.Soc., Series II, v 7: 554, Nov. 23, 1962.

Observations have been made, using a pulsed ruby optical maser, of the $6S_{1/2}-9D_{3/2}$ double-quantum absorption in cesium vapor ($\Delta\omega$ = 28 828 cm^{-1}) and the subsequent reemission via the $9D_{3/2}-6P_{3/2}$ transition at 5847A. The narrow absorption width of the $9D_{3/2}$ state requires careful thermal tuning of the ruby source to obtain coincidence, which occurs at λ(ruby) = 6935.6 ± 0.05A as measured on grating spectrograph plates. The observed fluorescence is, however, 2 orders of magnitude below the calculated value, but quenching Cs-Cs collisions can be expected to reduce the yield in the $9D_{3/2}$ decay.

633

Columbia U. Columbia Radiation Lab., New York.

HYPERFINE STRUCTURE OF THE METASTABLE $(4p)^5(5s)^3P_2$ STATE OF $_{36}Kr^{83}$, by W. L. Faust and L. Y. Chow Chiu. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J432) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)557], and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78330]) AD 407901 Unclassified

Also published in Phys. Rev., v. 129: 1214-1220, Feb. 1, 1963.

The hyperfine structure (hfs) of the metastable $(4p)^5(5s)\ ^3P_2$ state of $_{36}Kr^{83}$ (I = 9/2) has been measured by the atomic beam magnetic resonance method. The zero magnetic field intervals are: f(11/2 - 13/2) = 1830.7236(5) mc/sec, f(9/2 - 11/2) = 1341.8217(2) mc/sec f(7/2 - 9/2) = 956.5583(2) mc/sec, and f(5/2 - 7/2) = 656.0844(30) mc/sec. The 4 frequencies (after correction for second-order hyperfine interaction) are expected to be linearly related to only 3 interaction constants: A', B', and C' (respectively dipole, quadrupole, and octupole). The fit is satisfactory if, and only if, second-order hyperfine interaction is taken into account. The quadrupole and octupole moments of $_{36}Kr^{83}$ are Ω = 0.18(6)nm b (nuclear magneton barn) and Q = + 0.270(13) b. These values include no polarization corrections or corrections for any effects of configuration mixing. (Contractor's abstract)

634

Columbia U. Columbia Radiation Lab., New York.

MICROWAVE SPECTRUM, SPECTROSCOPIC CONSTANTS, AND ELECTRIC DIPOLE MOMENT OF Li^6F^{19}, by L. Wharton, W. Klemperer and others. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-J434) (In cooperation with Harvard U., Cambridge, Mass. and Martin Co., Orlando, Fla.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)557] and Atomic Energy Commission) AD 407113 Unclassified

Also published in Jour. Chem. Phys., v 38: 1203-1210, Mar. 1, 1963.

Transitions between the J = 1 and J = 0 rotational states of Li^6F^{19} have been measured by means of the molecular-beam electric resonance method in the 4 lowest vibrational states. By this means the rotational constants of Li^6F^{19} were determined. These enabled one to properly assign the rotationally resolved infrared vibration-rotation spectrum of Li^7F^{19} observed by Vidale and to determine the correct vibrational constants. Transitions between the M = 0 and M = 1 orientations of the J = 1 rotational state of Li^6F^{19} in the 4 lowest vibrational states in a strong electric field were measured to high precision, which enabled one to determine the dipole moments accurately and to observe a nonlinear variation of dipole moment with vibrational state. The molecular constants obtained for Li^6F^{19} were:

$B_\nu = 45.2308111 - 0.7223089(\nu + \frac{1}{2}) + 0.0058270(\nu + \frac{1}{2})^2 \pm$ 0.0000050 Gc, $\omega_\nu = 964.07 - 8.895(\nu + \frac{1}{2})\ cm^{-1}$,

$r_e = 1.563892 \pm 0.000050A$,

$\mu_\nu = 6.28446 + 0.08612(\nu + \frac{1}{2}) + 0.00060(\nu + \frac{1}{2})^2 \pm$ 0.00100 D.

635

Columbia U. [Columbia Radiation Lab.] New York.

LEVEL CROSSING IN THE $(5s5p)\ ^3P_1$ STATE OF 6.7 HOUR Cd^{107} (Abstract), by M. N. McDermott and P. Thaddeus. [1962] [1]p. (AFOSR-3271) [AF 49(638)936] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Also published in Bull. Amer. Phys. Soc. Series II, v. 7: 433, Aug. 27, 1962.

Two crossings of the Zeeman levels of the hyperfine structure of the $(5s5p)\ ^3P_1$ state of Cd^{107} (I = 5/2) have been detected by observing the change in intensity with magnetic field of the resonance fluorescence of the 2261A intercombination line. The isotope was produced

by the reaction $Ag^{107}(p, n)\ Cd^{107}$ in the Pupin cyclotron. The strongest crossing, that of the $|F, m_F> = |7/2, 7/2>$ and $|5/2, 3/2>$ levels, was observed at 1218.80(5) gauss, and the crossing of the $|5/2, 3/2>$ and $|5/2, -1/2>$ levels at 1036.3(2) gauss. A sample containing more atoms of the isotope may produce an increase in signal strength of 10 or more, allowing detection of the 2 additional $\Delta m_F = 2$ crossings already observed for Cd^{109}. Using these crossing fields, and the value of g_J obtained from a level crossing experiment on the stable Cd isotopes, we calculate, neglecting second order interactions due to neighboring fine structure levels, the hyperfine coupling constants to be: A = -853.59(2) mc/sec, and B = -163.8(2) mc/sec, in agreement with the results of a double resonance experiment.

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Columbia U. [Columbia Radiation Lab.] New York.

DETECTION OF LEVEL CROSSINGS IN BACK-SCATTERING (Abstract), by R. J. Goshen, A. Landman, and R. Novick. [1962] [1]p. (AFOSR-3272) [AF 49-(638)936] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Also published in Bull. Amer. Phys. Soc., Series II, v. 7: 433, Aug. 27, 1962.

Multiple scattering limits the maximum vapor density in the normal level crossing and double resonance experiments. The signal strength decreases precipitously as the optical density of the vapor is increased beyond that corresponding to about one absorption depth in the cell. This limitation can be overcome by observing the fluorescence in the backward direction. At high density and in the absence of collisions, substantially all of the incident light is backscattered, and one would expect that the signals would be independent of temperature. The observation of level crossing and double resonance at high density would allow the study of self-broadening and the study of isotopically dilute radioactive species. We have observed level crossing signals in the $(5s5p)^1P_1$ state of cadmium with backscattering and Cd pressures up to 2×10^{-2} mm Hg. This pressure is 200 times greater than that at which level crossings are observable with either forward or 90° scattering. The observed signal strength is substantially independent of pressure from 10^{-5} mm Hg (the lowest investigated) to 2×10^{-2} mm Hg. At the higher pressures we have observed self-broadening.

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Columbia U. [Columbia Radiation Lab.] New York.

COHERENCE-NARROWING, PRESSURE-BROADENING AND WALL COLLISION-BROADENING OF THE $(5s5p)^3P_1$ STATE OF CADMIUM (Abstract), by F. Byron, M. N. McDermott, and R. Novick. [1962] [1]p. [AF 49(638)-936] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 26, 1962.

The optical double resonance method has been used to study the temperature dependence of the width of Zeeman resonance in the $(5s5p)\ ^3P_1$ state of cadmium. For relatively low temperatures (100°-150°C) the half-width, extrapolated to zero rf-field, is found to be 138 ± 2kc. As the temperature is increased beyond this region, the line narrows until a minimum half-width of about 100 kc is found near 240°C. Beyond this temperature the width increases and grows very rapidly above 300°C. The initial constant value is interpreted to be the natural half-width of the line, apart from the effect of collisions with the walls. When a correction is made for the effect of wall collisions, the natural half-width is found to be 131 ± 3 kc, which gives a radiative lifetime of $(2.43 \pm 0.03) \times 10^{-6}$ sec. The line narrowing is believed to be the result of coherence-narrowing. The broadening at higher temperatures is proportional to $P/\sqrt{T}$ and yields an apparent collision cross-section of 4×10^{-14} cm^2; difficulties in determining vapor pressure make this number uncertain by a factor of about 2. This rather large cross-section may be interpreted as the result of a dipole-dipole collision interaction (Holtzmark-broadening).

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Columbia U. [Columbia Radiation Lab.] New York.

LEVEL CROSSINGS IN THE $(5s5p)\ ^3P_1$ STATE OF RADIOACTIVE Cd^{109} (Abstract), by P. Thaddeus and M. N. McDermott. [1962] [1]p. [AF 49(638)936] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 25, Jan. 24, 1962.

Four crossings of the Zeeman levels of the hyperfine structure of the $(5s5p)\ ^3P_1$ state of Cd^{109} (I = 5/2) have been detected by observing the change in intensity of the resonance fluorescence of the 3261A intercombination line. This isotope has a half life of 470 days and was produced by the reaction $Ag^{109}(p, n)Cd^{109}$ in the Columbia cyclotron. The magnetic field at which crossing occurs in units of the NMR frequency of protons in mineral oil, together with the low field assignments of the crossing levels are: $|F, m_F> = |7/2, 7/2>$ and $|5/2, 3/2>$ at 6986.995(6)kc/sec, $|5/2, 3/2>$ and $|5/2, -1/2>$ at 6177.49(6)kc/sec, $|5/2, 1/2>$ and $|5/2, -3/2>$ at 5593.84(16)kc/sec, and $|5/2, -1/2>$ and $|5/2, -5/2>$ at 5007.73(24)kc/sec. These crossing fields are consistent with the hyperfine intervals of the $(5s5p)\ ^3P_1$ state as determined by a double resonance experiment, and should permit a more precise determination of the hyperfine constants.

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Columbia U. [Columbia Radiation Lab.] New York.

NUCLEAR MOMENTS OF Cd^{107} (Abstract), by M. N. McDermott, F. Byron, and R. Novick. [1962] [1]p. [AF 49(638)936] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II v. 7. 25, Jan. 24, 1962.

Earlier work (item no. 559, Vol. V) on the radioisotope, Cd^{107}, has been extended to include a determination of the hyperfine structure in the 5^3P_1 state. An optical double resonance method was used as before. However, considerable improvement in experimental technique has made it possible to observe Zeeman resonances in both the F = 7/2 and F = 3/2 hyperfine structure levels with a good signal-to-noise ratio. The hyperfine intervals derived from Zeeman transitions observed at 2 different frequencies are F = 7/2 ↔ F = 5/2, ν = 3164(9) mc/sec and F = 5/2 ↔ F = 3/2, ν = 1894(9) mc/sec. The hyperfine interaction constants derived from these intervals are A = -855(2) mc/sec and B = -163(5) mc/sec. The negative sign for A was determined by a subsidiary experiment. From the hyperfine constants, values for the nuclear dipole moment $\mu = -0.617(2)\mu_N$ and nuclear quadrupole moment Q = +0.78(0) barns are obtained. In addition, the new measurements have further confirmed the nuclear spin assignment of I = 5/2.

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Columbia U. [Columbia Radiation Lab.] New York.

NUCLEAR SPIN AND MOMENTS OF 245 DAY Zn^{65} (Abstract), by M N. McDermott, B. Perry, and R. Novick. [1962] [1]p. [AF 49(638)936] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 533, Nov. 23, 1962.

The nuclear spin and hyperfine interactions constants of 245 day Zn^{65} have been determined by the optical double-resonance technique in the $(4s4p)^3P_1$ atomic state. The nuclear spin I, magnetic dipole constant A, and electric quadrupole coupling constant B, are I = 5/2, A = 535.08(12) mc/sec, and B = 3.3(5) mc/sec. The signs of A and B have been determined with circularly polarized light. Neglecting nuclear structure and quadrupole antishielding corrections, the corresponding nuclear moments are μ = 0.76944(17)nm and Q = -0.027(4)b. The Zn^{65} was produced by a (p, n) reaction on 99.99% pure copper. Approximately 2×10^{15} atoms were used in the experiment. The Zn^{65} magnetic moment is 12% smaller than that of Zn^{67} (I = 5/2). The Zn^{67} quadrupole moment has the opposite sign and is a factor of 7 larger than that of Zn^{65}

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Columbia U. [Columbia Radiation Lab.] New York.

NUCLEAR SPIN AND MOMENTS OF Cd^{115m} (Abstract), by B. Perry, M. N. McDermott, and R. Novick. [1962] [1]p. [AF 49(638)936] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 533, Nov. 23. 1962.

The nuclear spin and hyperfine structure constants of 43 day Cd^{115m} have been determined by the optical double-resonance technique in the $(5s5p)^3P_1$ state. The nuclear spin I, magnetic dipole constant A, and electric quadrupole coupling constant B, are I = 11/2, A = (−)648(6) mc/sec, and B = (+)149(12) mc/sec. The sign of A/B has been determined to be negative in the present experiment, but the separate signs of A and B have not yet been directly determined. Assuming an $h_{11/2}$ odd-neutron assignment, a negative μ is expected. With this assumption and the known sign of the ratio A/B, a negative Q is found. Neglecting nuclear structure and quadrupole antishielding corrections, the nuclear moments are μ = -1.028(10)nm, Q = -0.68(5)b. The Cd^{115m} was produced by a (n, γ) reaction on separated Cd^{114}. After irradiation, the Cd^{115m} was separated from the Cd^{114} in the electromagnetic mass separator at the Argonne National Laboratories. Approximately 1.5×10^{11} atoms were used in the experiment.

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Columbia U. [Columbia Radiation Lab.] New York.

OPTICAL DETECTION OF LEVEL CROSSINGS IN Zn^{65} (Abstract), by A. Landman and M N. McDermott. [1962] [1]p. [AF 49(638)936] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 533, Nov. 23, 1962.

The crossings of the F = 7/2, m = -7/2 and F = 5/2, m = -3/2 levels of the $(4s4p)^3P_1$ state of Zn^{65} (I = 5/2) has been detected by observing the change in the angular distribution of resonance fluorescence in the Zn 3076 intercombination line. The crossing field was found to be 764.12 ± 0.02 G. Another crossing, believed to be that of the F = 5/2, m = 1/2 and F = 5/2, m = -3/2 levels, was observed at 756.7 G. These results, together with the value for g_J of 1.50096 obtained previously in the case of Zn^{67}, lead to the following values for the hyperfine interaction constants: A = 535.08 ± 0.02 mc/sec and B = +5 ± 1 mc/sec. These results are consistent with the double-resonance measurements of McDermott et al. (see item no. 640, Vol. VI).

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Columbia U. Columbia Radiation Lab., New York.

PROPERTIES OF ATOMIC IONS. Final rept. Dec. 1, 1960-Nov. 30, 1962, 31p. incl. diagr. table. (AFOSR-4747) (AF 49(638)996) AD 409441 Unclassified

Studies on the properties of atomic ions were divided into 4 categories: (1) the lifetime of the metastable helium ion, (2) level crossing spectroscopy, (3) atomic lifetimes, and (4) a study of the metastable lithium atom. The status of each of these areas of research is presented in detail. (Contractor's abstract)

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Columbia U. [Columbia Radiation Lab.] New York.

Hfs OF THE $^1P_1$ STATE OF Cd^{111} (Abstract), by R. Novick and A. Lurio. [1962] [1]p. [AF 49(638)996] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 258-259, Apr. 23, 1962.

The magnetic field at which the $F = \frac{1}{2}, m_F = -\frac{1}{2}$ and the $F = \frac{3}{2}, m_F = +\frac{3}{2}$ Zeeman levels (A assumed negative) in the $^1P_1$ state of Cd^{111} become degenerate has been determined by the level-crossing technique. A quartz cell containing 92% Cd^{111} was irradiated with the 2288-A ($^1S_0 - {}^1P_1$) resonance line, and the scattered radiation was observed at 90° to the incoming radiation. The scattered-light intensity was recorded as a function of magnetic field at the cell. The field was perpendicular to the plane formed by the incident and outgoing photons. Intensity changes corresponding to level crossings at zero field and at a field of 122 ± 12 gauss were observed. The 12-gauss uncertainty includes allowance for the possible shift resulting from the fact that the 122-gauss crossing is superimposed on the wings of the zero-field crossing. An exact calculation of the combined zero field and the 122-gauss field-crossing effects is in progress. From the values of the magnetic field at the crossing, the dipole-coupling constant of the $^1P_1$ state of Cd^{111} is found to be $|A| = g_J \mu_0 H = 171$ mc. The theory of the hfs of the 5s5p configuration combined with other experimental results yields a predicted value of $A(^1P_1)$ of -122 mc.

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Columbia U. [Columbia Radiation Lab.] New York.

AN INTENSE SOURCE OF MONOENERGETIC METASTABLE HELIUM IONS (Abstract), by M. Lipeles, L. Gampel, and R. Novick. [1962] [1]p. [AF 49(638)996] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 69, Jan. 24, 1962.

A 10-m long slow (10 ev) metastable helium ion beam apparatus is being constructed for the determination of the radiative lifetime of the 2S state of hydrogenic atoms. Ultra-high vacuum techniques and differential pumping are being employed to reduce the loss of metastable ions by either Stark quenching or collision quenching. The ions are produced in an electrostatically focussed electron bombardment ion source. Ions that drift out of a 4-mm gridded hole in the source are accelerated by a converging spherical condenser and pass through a 1 cm long, 2.3 mm diam channel. This narrow channel provides a pressure reduction ratio of 35:1 between the source chamber and a vacuum separating chamber. Total ion currents of 5×10^{-8} amp at 10-ev beam energy have been obtained. The energy spread in the beam is less than 1 ev and about 1% of the ions are in the metastable state.

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Columbia U. [Columbia Radiation Lab.] New York.

LIFETIME OF THE $5s5p\,^1P_1$ STATE OF Cd AND COHERENCE NARROWING OF THE 228A ($^1S_0 - {}^1P_1$) LEVEL CROSSING RESONANCE SIGNAL (Abstract), by R. Novick, P. Horwitz and others. [1962] [1]p. [AF 49(638)996] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Amer. Phys. Soc., Series II, v. 7: 258, Apr. 23, 1962.

The zero magnetic-field level crossing (Hanle effect) in the $5s5p\,^1P_1$ state of Cd^{114} has been used to determine the lifetime of the Cd $^1P_1$ atomic state. A quartz cell containing 98.2% Cd^{114} was irradiated with 2288-A resonance radiation. The intensity of the fluorescence emitted at 90° was observed as a function of the cell temperature and magnetic field. A Lorentzian level-crossing signal was observed at zero field; no other crossings were detected as the field was swept from +150 to -150 gauss. The field width of the crossing signal decreased as the cell temperature was increased.

The lifetime of the $^1P_1$ state is determined to be $1.59 \pm 0.08 \times 10^{-9}$ sec by extrapolating the width of the crossing signal to zero cadmium density. This value is significantly lower than earlier values.

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Columbia U. [Columbia Radiation Lab.] New York.

LIFETIME OF THE METASTABLE HELIUM ION (Abstract), by E. Commins, L. Gampel and others. [1962] [1]p. [AF 49(638)996] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 258, Apr. 23, 1962.

The apparatus described previously has been used to make a preliminary determination of the lifetime of the 2S state of the helium ion. The metastable component of the beam is modulated by allowing the ions to pass through a microwave-quenching field that is turned on and off at 280 cps. The metastable and ground-state ions are detected on a surface detector that can be moved over the full length of the apparatus. The ground-state ions give rise to a steady detector current, while the metastables produce a 280-cps signal through the surface Auger effect. The ac metastable signal is normalized against the dc ground-state signal to eliminate many of the systematic errors that might otherwise occur. The normalized metastable signal decreases by about 20% during the 400-μsec transit time in the apparatus. This is consistent with the 1.9-msec radiative lifetime predicted for the 2S state of He^+.

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Columbia U. [Columbia Radiation Lab.] New York.

OPTICAL DETECTION OF LEVEL CROSSINGS IN Zn^{67} (Abstract), by A. Landman, P. Thaddeus, and R. Novick. [1962] [1]p. [AF 49(638)996] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 26, Jan. 24, 1962.

The crossing of the F = 7/2, m = -7/2 and F = 5/2, m = -3/2 levels of the $(4s41)^3P_1$ state of Zn^{67} (I = 5/2) has been detected by observing the change in the angular distribution of resonance fluorescence in the Zn 3076 intercombination line. The crossing field was found to lie near 870 gauss. This result is consistent with the double resonance measurements of Böckmann et al. The crossing was observed in natural zinc (4% Zn^{67}) with narrow-band phase sensitive detection. More precise measurements are in progress with enriched Zn^{67} and an analysis is being made of the second-order fine structure corrections to the theoretical position of the crossing.

649

Columbia U. [Columbia Radiation Lab.] New York.

OPTICAL DOUBLE-PHOTON ABSROPTION IN CESIUM VAPOR, by I. D. Abella. [1962] [3]p. incl. illus. refs. (AFOSR-J86) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-49, Office of Naval Research, and Signal Corps) AD 400456 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 453-455, Dec. 1, 1962.

An experiment is described in which light of frequency 14400 cm^{-1} from a ruby maser was made to excite the $6S_{1/2}$-$9D_{3/2}$ transition in Cs, whose frequency is 23829 cm^{-1}. Careful discussion of other possible effects shows that the mechanism is likely to be a 2-photon absorption by a Cs atom.

650

Columbia U. Columbia Radiation Lab., New York.

OPTICAL HARMONIC FREQUENCY RADIO MEASUREMENTS, by I. D. Abella. [1962] [2]p. (AFOSR-J87) [AF AFOSR-62-49] AD 400455 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 50: 1824-1825, Aug. 1962.

Harmonics of the output of a ruby laser were generated by focusing the output on a KDP crystal at 45° to the X-Y axis and normal to the Z axis, with the object of checking reports of discrepancy in the expected 2:1 ratio between harmonic and fundamental frequency. Near the threshold, the expected 2:1 ratio was observed, but at higher intensities, the harmonic line was displaced towards the blue by as much as 10 ppm. This result is consistent with the hypothesis of thermal tuning in the maser.

651

Columbia U. Columbia Radiation Lab., New York.

LINEAR POLARIZATION OF THE 3200-MC/SEC RADIATION FROM SATURN, by W. K. Rose, J. M. Bologna, and R. M. Sloanaker. [1962] [3]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-49], Office of Naval Research, and Signal Corps) Unclassified

Published in Phys. Rev. Ltrs., v. 10: 123-125, Feb. 15, 1963.

Data obtained by means of drift curves, using a solid-state maser amplifier at the focus of the 84 ft W. R. L. (U.S.A.) radiotelescope, yield a 20 ± 8% linear polarization of the 3200 mc/sec^{-1} radiation from Saturn, the position angle for maximum intensity being nearly perpendicular to the planets equatorial plane.

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Columbia U. Columbia Radiation Lab., New York.

ESR SPECTRA OF THE OH, Ti^{3+} IONS AND COLOR CENTERS IN RUTILE AS REVEALED BY A HIGH SENSITIVITY DIELECTRIC RESONANCE SPECTROMETER, by A. Okaya. [1962] [2]p. (AFOSR-64-2331) (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., Stanford U., Calif., Dec. 27-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 613, Dec. 27, 1962. (Title varies)

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 687-688, 1963.

The isotropic g ≃ 2 spectrum on slightly reduced single-crystal rutile consisted of strong Ti^{3+}, medium OH, and 2 other weak-color center lines. The hydrogen-reduced and deuterium-reduced samples showed an OH line at 3280 cm^{-1} and an OD line at 2450 cm^{-1}, respectively. The fine structures in both Ti^{3+} and OH lines show that these are frequently coupled as a pair isotropically. The coupling is due to the exchange interaction $JS_1.S_2$ between electron spins; J was estimated to be about 3.5×10^{-4} cm^{-1}. $I \cdot S_2$ coupling was observed in the OH spectrum as an anisotropic hyperfine structure. Another 2 weak isotropic lines of g ≃ 1.96 and g ≃ 1.88 (at θ = 0, φ = 0) are suspected to be due to the color centers at oxygen vacancies. Very weak isotropic lines were observed at exactly half the magnetic field of g ≃ 2 line. The line structure was much simpler than g ≃ 2 lines, and no fine structure was observed. The lines were interpreted as due to $\Delta M_S = 2$, $\Delta M_F = 1$ (where F = I + S) transitions, and 3 single lines in the reduced sample were interpreted as OH-OH and Ti^{3+}-O-Ti^{3+} and Ti^{3+}-O-H pairs. The line shape of several spectra did not satisfy the Kramer-Kronig relations even if the lines were not saturated.

653

Columbia U. [Columbia Radiation Lab.] New York.

DETECTION OF LEVEL CROSSINGS IN BACKSCATTERING (Abstract), by R. J. Goshen, A. Landman, and R. Novick. [1962] [1]p. (AFOSR-5466) [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Also published in Bull. Amer. Phys. Soc., Series II, v. 7: 433, Aug. 27, 1962.

For abstract see item no. 636, Vol. VI.

654

Columbia U. [Columbia Radiation Lab.] New York.

LEVEL CROSSINGS IN THE $(5s5p)^3P_1$ STATE OF 6.7 HOUR Cd^{107} (Abstract), by M. N. McDermott and P. Thaddeus. [1962] [1]p. (AFOSR-5467) (Sponsored jointly by Air Force Office of Scientific Research [Office of Naval Research, and Signal Corps under DA 36-039-sc-78330]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962

Also published in Bull. Amer. Phys. Soc., Series II, v. 7: 433, Aug. 27, 1962.

For abstract see item no. 635, Vol. VI.

655

Columbia U. [Columbia Radiation Lab.] New York.

LIFETIMES OF THE $^1P_1$ STATES OF Ca, Sr AND Zn (Abstract), by R. DeZafra, R. J. Goshen and others. [1962] [1]p. (AFOSR-5468) (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Also published in Bull. Amer. Phys. Soc., Series II, v. 7: 433, Aug. 27, 1962.

The lifetimes of the $^1P_1$ states of Zn, Sr, and Ca were determined by observing zero field level crossings (Hanle effect). The Zn was studied in a quartz cell, the Sr in an atomic beam, and the Ca in a beam and also in a single crystal magnesium oxide cell. Flow lamps were used as the source of resonance radiation. Phase sensitive detection was employed for the cell observations and direct photo-electric recording for the beam studies. Coherence narrowing was observed in all cases. Level crossing curves of Lorentzian shape and good signal-to-noise ratio were observed for each element. The lifetimes of the $(4s4p)^1P_1$ state of Ca and Zn are $(4.8 \pm 0.5) \times 10^{-9}$ sec and $(1.36 \pm 0.10) \times 10^{-9}$ sec, respectively. The lifetime of the $(5s5p)^1P_1$ state of Sr is $(6.1 \pm 0.6) \times 10^{-9}$ sec. All of these lifetimes are appreciably shorter than those obtained in earlier work. However, the Ca and Sr values are in good agreement with recent optical results obtained by Ostrovskii et al.

656

Columbia U. Columbia Radiation Lab., New York.

DETECTION OF THE MICROWAVE ν_{27-} LINE OF MOLECULAR OXYGEN PRODUCED IN THE HIGH ATMOSPHERE, by W. Kahan. [1962] [3]p. incl. diagrs. refs. (AFOSR-J1380) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-50 and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78330]) Unclassified

Also published in Nature, v. 195: 30-32, July 7, 1962.

For abstract see item no. 639, Vol. VI.

657

Columbia U. Columbia Radiation Lab., New York.

A HIGH ENERGY LASER USING A MULTI-ELLIPTICAL CAVITY, by H. Z. Cummins. [1962] [2]p. (AFOSR-J1393) ([Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330]) Unclassified

Also published in Proc. Inst. Elec. and Electron. Engineers, v. 51: 254-255, Jan. 1963.

Consider an infinitely long source located at one focus of a perfectly reflecting elliptical cylinder and assume that the thickness of the source is negligibly small compared to the dimensions of the ellipse. An object located at the second focus will then receive all the energy radiated by the source and will, in the absence of any loss mechanisms, come to thermal equilibrium with the source. Under these conditions, modification of the geometry to the multi-elliptical design can produce no gain. Optically, this conclusion follows from the consideration that the radiant flux received by a point on the image axis depends on the solid angle subtended by the ellipse at that point, and is the same for a single source or a multi-source geometry. The same conclusion follows from the second law of thermodynamics. According to C. Bowness et al, Proc. IRE, v. 50: 1704-1705, July 1962, the structure could have 4 black-body sources of temperature T located on the 4 source axes. If then, as the authors state, the efficiency of each of the 4 cavities can be 75% of that of a single ellipse, a line object located on the common focal axis would attain an equilibrium temperature greater than T, in clear violation of thermodynamic principles. The authors' remark that the loss in efficiency is caused by the removal of the cavity wall in the region about the axis common to all the ellipses. The loss, however, is not 25% (solid angle lost viewed from the source) as they conclude, but 75% (solid angle lost viewed from the image), so that the total efficiency is (ideally) 25% per ellipse, and nothing has been gained.

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Columbia U. [Columbia Radiation Lab.] New York.

HYPERFINE STRUCTURE IN $O^{17}H$ AND THE OH DIPOLE MOMENT, by G. Ehrenstein. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J1405) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330) Unclassified

Also published in Phys. Rev., v. 130: 669-675, Apr. 15, 1963.

A microwave spectrometer for the study of free radicals or other reactive species is described; it can be used with either Stark or Zeeman modulation. This spectrometer was used to determine the hyperfine structure of $O^{17}H$. Four main lines of the $^2\pi_{3/2}$, J = 7/2 A-doubling transition were definitely observed, and there is evidence that 1 satellite line was also detected. Quantum number assignments were made for the 4 main lines, which are divided into 2 doublets. In the course of establishing the uniqueness of these assignments, the A-doubling frequency for the $^2\pi_{3/2}$, J = 7/2 state of $O^{18}H$ was experimentally determined. The separation between doublets in the $O^{17}H$ spectrum was used to determine the hyperfine constant d associated with the O^{17} nucleus. The constant d was also computed theoretically from a simple molecular model of OH in which a single unpaired pπ electron about the O^{17} nucleus is assumed. The experimental value is about 8% greater in magnitude than the theoretical value, and this difference is discussed. The same spectrometer was used for the determination of the electric dipole moment of OH by measuring the Stark shift of the $^2\pi_{3/2}$, J = 7/2, M = 4 A-doubling line of $O^{16}H$ at a known electric field. The OH dipole moment was found to be 1.60 ± 0.12 D. (Contractor's abstract)

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Columbia U. [Columbia Radiation Lab.] New York.

SPURIOUS HARMONIC GENERATION IN OPTICAL HETERODYNING, by H. Z. Cummins, N. Knable, and Y. Yeh. [1962] [3]p. incl. diagrs. (AFOSR-J1407) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and [Signal Corps] under DA 36-039-sc-78330; Army Research Office (Durham) and National Science Foundation) Unclassified

Also published in Appl. Opt., v. 2: 823-825, Aug. 1963.

An experiment is described in which the simultaneous photodetection of 2 incoherent light beams chopped at different frequencies yields a direct measurement of the cross-modulation coefficient of a photocathode. This is a technique generally applicable to the measurement of small nonlinearities in photodetectors.

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Columbia U. Columbia Radiation Lab., New York.

HYPERFINE STRUCTURE OF THE METASTABLE $(4p)^5(5s)\ ^3P_2$ STATE OF $_{36}Kr^{83}$, by W. L. Faust and L. Y. Chow Chiu. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J1408) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)557] and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78330]) Unclassified

Also published in Phys. Rev., v. 129: 1214-1220, Feb. 1, 1963.

For abstract see item no. 633, Vol. VI.

661

Columbia U. Columbia Radiation Lab., New York.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM, by R. Novick. Quarterly progress rept. no. 8, Sept. 16-Dec. 15, 1961, 71p. incl. diagrs. table, refs. (Rept. no. CU-12-61) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330) Unclassified

A number of projects involving the optical detection of energy level crossings are described, including work on various isotopic species of Zn and Cd. Results are given for the lifetimes of certain of these states. A new experiment is described for the measurement of the hyperfine structure of Li ions. Several optical double-resonance studies are reported, including work on Na and radioactive Cd. New experimental programs are described in microwave spectroscopy of molecules, the production of cryogenic magnets, and a Rb "atomic clock". Final results are given for measurements of the $O^{17}H$ free radical. Microwave and optical maser research is discussed. A new experiment for measuring the microwave properties of simulated planetary atmospheres is in progress.

662

Columbia U. Columbia Radiation Lab., New York.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM, by R. Novick. Quarterly progress rept. no. 9, Dec. 16, 1961-Mar. 15, 1962, 66p. incl. illus. diagrs. refs. (Rept. no. CU-3-62) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330) AD 275422 Unclassified

Several modifications of the 30-ft beam apparatus which will be used to measure the lifetime of the metastable state of helium ions are described. Level crossing experiments utilizing optical methods (double resonance methods) have been employed to measure the hyperfine Zeeman structure of isotopes of Zn, Na, Rb, and Cd. Complete results are given for the radiative lifetime of the $^3P_1$ state of Cd. A new experiment for measuring the electronic fine structure of ionized Li is under way. Similar experiments are proposed for various states of Ca and Sr. Several radioactive species were studied by the double resonance technique, principally Cd and Ca. Progress is described on several molecular physics projects, including molecular beams experiments employing velocity selection and electric resonance, and microwave and maser spectroscopy. Several advances in the optical maser program are described. (Contractor's abstract, in part)

663

Columbia U. Columbia Radiation Lab., New York.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM, by R. Novick. Quarterly progress rept. no. 10, Mar. 16-June 15, 1962, 75p. incl. diagrs. refs. (Rept. no. CU-6-62) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330) Unclassified

A new program for the study of defects in solids by electron-nuclear double resonance techniques is reported. A precise value of the O^{15} magnetic moment has been obtained and compared with the known moment of the mirror nucleus N^{15}. A 47 000 gauss superconducting magnet has been successfully operated. Precise values for the hyperfine splitting of a rotational transition in the HDS have been obtained with the maser beam spectrometer. Final results are reported on the microwave spectrum of $O^{17}H$. Precise values for the lifetimes of the first excited resonance state of Cd, Zn, Ca, and Sr have been obtained by level crossing spectroscopy. A new method of level crossing spectroscopy is reported in which backscattered signals are utilized to observe crossings in the presence of heavy trapping. This technique is being applied to the study of atomic collision phenomena in resonance states. A new molecular beam electric resonance apparatus is being constructed for the study of molecular hyperfine structure. The high pressure microwave absorption of CO_2 has been determined. This information will be used in connection with a study of the atmosphere of Venus.

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Columbia U. Columbia Radiation Lab., New York.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM, by R. Novick. Quarterly progress rept. no. 11, June 16-Sept. 15. 1962, 57p. incl. illus. diagrs. tables, refs. (Rept. no. CU-9-62) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78330) AD 290306 Unclassified

Double photon excitation of the $6S_{1/2}$-$9D_{3/2}$ transition in atomic cesium has been observed when the vapor is illuminated with the intense light of a pulsed ruby laser. These observations provide a simple and direct test of the theory of 2 photon processes. New values are reported for the spin, magnetic moment, and quadrupole moment of 245 day Zn^{65} and 43 day of Cd^{115m} These results were obtained by optical double resonance. New precise values of the level crossing fields in 6.7 hour Cd^{107} and 245 day Zn^{65} are reported. A program of solid state research involving a study of the demagnetized state has been initiated. The demagnetized state will be achieved by adiabatic demagnetization in the rotating frame; it is expected that this technique will be useful in the study of rare spins. Polarization studies at S band have been made on a number of radio sources with the NRL radio telescope and a 9.4 cm maser preamplifier that was designed and constructed at CRL. Large polarization was found in Hercules A, 3C 433, and 3C 295. (Contractor's abstract)

665

Columbia U. Columbia Radiation Lab., New York.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM, by R. Novick. Quarterly progress rept. no. 12, Sept. 16-Dec. 15, 1962, 64p. incl. illus. table, refs. (Rept. no. CU-12-62) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-90789) AD 296893 Unclassified

Evidence has been found for the existence of the $(1s2s2p)\,^4P_{5/2}$ metastable state of the lithium atom. This state decays by authorization with a lifetime of about 10 μsec. In addition to its intrinsic interest, this state and similar states in other atoms warrant study because they may serve as useful sources of polarized electrons and ions. Final results are reported on the magnetic moment of O^{15}. Precise values for the zero field hyperfine intervals and the level crossing fields of 245 day Zn^{65} are reported. The spin, magnetic moment, and quadrupole moment of 43 day Cd^{115m} have been determined by optical double resonance. Theoretical calculations of the moments of the cadmium and zinc isotopes have been made on the basis of the configuration mixing model; these are compared with the experimental values. New precise values of the HDS molecular parameters have been deduced from the measurements reported previously. Initial results are reported on the optical maser spectroscopy program. In the cooperative radio-astronomy program with the Naval Research Lab., it has been found that the 3200 mc/sec radiation from Saturn is linearly polarized and that the magnetic poles of Saturn appear to be located in the equatorial plane of the planet. (Contractor's abstract)

666

Columbia U. Dept. of Chemistry, New York.

THE MICROWAVE SPECTRUM AND STRUCTURE OF PROPIONITRILE, by R. G. Lerner and B. P. Dailey. [June 1, 1956] [3]p. incl. tables, refs. (AFOSR-3566) (AF 18(600)1152) Unclassified

Also published in Jour. Chem. Phys., v. 26: 678-680, Mar. 1957.

For abstract see item no. COU.03:012, Vol. I.

667

Columbia U. Dept. of Chemistry, New York.

MICROWAVE SPECTRUM AND STRUCTURE OF FORMIC ACID, by R. G. Lerner, B. P. Dailey, and J. P. Friend. [June 1, 1956] [4]p. incl. tables. (AFOSR-3867) (AF 18(600)1152) Unclassified

Also published in Jour. Chem. Phys., v. 26: 680-683, Mar. 1957.

For abstract see item. no. COU.03:011, Vol. I.

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Columbia U. [Dept. of Chemistry] New York.

ALTERNATING LINEWIDTHS IN THE ESR SPECTRA OF DINITROBENZENE ANION RADICALS, by J. H. Freed, P. H. Rieger, and G. K. Fraenkel. [1962] [2]p. incl. diagr. (AFOSR-J321) (AF 49(638)520) Unclassified

Also published in Jour. Chem. Phys., v. 37: 1881-1882, Oct. 15, 1962.

An alternation of line-widths in the hyperfine structure due to 2 equivalent nitrogen nuclei is found in m-, dinitrobenzene but not in para and ortho derivatives. This is interpreted in terms of a time dependent fluctuation in the difference of the splitting constants for each separate nucleus. The time dependence is supposed to arise from collisions with solvent molecules and from the formation of short-lived complexes with the solvent molecules.

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Columbia U. Dept. of Chemistry, New York.

ANOMALOUS ALTERNATING LINEWIDTHS IN ESR SPECTRA, by J. H. Freed and G. K. Fraenkel. [1962] [2]p. incl. illus. (AFOSR-J322) (AF 49(638)520) AD 453519 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1156-1157, Sept. 1, 1962.

An anomalous alteration in the widths of the hyperfine components was found in the ESR spectrum of the 1, 4-dinitrotetramethylbenzene anion radical. A mechanism which explains this effect is discussed which involves the modulation of the hyperfine interaction with the nitrogen nuclei by a correlated hindered rotation of the pair of nitro groups.

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Columbia U. [Dept. of Chemistry] New York.

ELECTRON SPIN RESONANCE OF AZULENE ANION RADICALS, by I. Bernal, P. H. Rieger, and G. K. Fraenkel. [1962] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-J323) (AF 49(638)520) AD 453520 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1489-1495, Oct. 1, 1962.

The electron spin resonance spectra of the anion radical azulene, azulene-1, 3-d_2, 4, 6, 8-trimethylazulene, and 4, 6, 8-trimethylazulene-1, 3-d_2 have been examined. These hydrocarbons are nonalternant and have aromatic ring structures with C–C–C bond angles that depart from 120°. Sigma-pi-interaction calculations of the parameter Q_{CH}^{H} [in the relation $a_i^H = Q_{CH}^{H} \rho_i^{\pi}$ between the isotropic proton hyperfine splitting (a_i^H) and pi-electron spin density (ρ_i^{π})] have been performed as a

function of the bond angles at the carbon atom bonded to the proton. These calculations indicate a strong dependence of this parameter on angle. By using recent x-ray data on azulene, predictions could be made of the Q's at the different positions in the radicals. In contrast, the proton splitting at a methyl-group substituent, determined by the parameter $Q_{CCH_3}^{H}$, is predicted to be independent of the bond angles at the carbon atom of the aromatic system. Calculations of the pi-electron spin density were made in both the simple Hückel and the McLachlan extended self-consistent field molecular-orbital theory approximations. These calculations were used with the experimental splitting constants to make a comparison with the predicted bond-angle variation of sigma-pi interaction parameters (Q's). The McLachlan procedure gives much more satisfactory results than the Hückel calculations, but the agreement with experiment involving use of the predicted dependence of Q_{CH}^{H} on bond angle, is only approximate. The theoretical estimates of the variation of Q_{CH}^{H} with bond angle, and of the constancy of $Q_{CCH_3}^{H}$, appears to be qualitatively correct. Applications of the theory for the change of Q_{CH}^{H} with angle may in some instances necessitate taking into account bent bonds. (Contractor's abstract)

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Columbia U. [Dept. of Chemistry] New York.

ELECTRON SPIN RESONANCE LINEWIDTHS IN MULTISUBSTITUTED BENZENE RADICALS (Abstract), by J. [H.] Freed, I. Bernal, and G. K. Fraenkel. [1962] [1]p. [AF 49(638)520] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 44, Jan. 24, 1962.

An unusual linewidth pattern has been observed in the electron spin resonance spectrum of dilute liquid solutions of certain multisubstituted benzene radicals. This effect is observed at a field of 9200 mc/sec and consists of a regular alternation of sharp and broadened hyperfine lines. These hyperfine splittings, which arise from the isotropic interactions between the unpaired electron and the magnetic nuclei, are proportional to the odd-electron spin densities at these nuclei. The broadened lines correspond to odd values of the z component of the total nuclear spin of equivalent nuclei. The equivalent nitro groups in radicals such as the dinitrodurene and dinitromesitylene anions give rise to this linewidth alternation, as do the equivalent methyl groups in protonated durosemiquinone positive ion. In related radical anions, such as mononitrodurene, mononitromesitylene, 2-nitrometaxylene, and unprotonated durosemiquinone, no such effect has been distinguished. The phenomenon is attributed to the steric hindrance between the ring substituents and hence to their coupled hindered motions leading to a nuclear-spin-dependent intromolecular line broadening process. Temperature-dependence linewidth studies show an enhancement of this effect at low temperatures.

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Columbia U. Dept. of Chemistry, New York.

ELECTRON SPIN RESONANCE SPECTRA OF CARBONYL ANION RADICALS, by P. H. Rieger and G. K. Fraenkel. [1962] [21]p. incl. diagrs. tables, refs. (AF 49(638)520) Unclassified

Published in Jour. Chem. Phys., v. 37: 2811-2831, Dec. 15, 1962.

Electron spin resonance studies are reported on the anion radicals of single-ring aromatic compounds containing aldehyde, acetyl, or amide groups, as well as other substituents. Many of the radicals have spectra which indicate that the carbonyl group is locked in a conformation planar with the ring for times of the order of a μsec or longer. The para dicarbonyls and the 3-cyanoacetophenone anion were found to be present in both the cis and trans modifications. A simple modification of conventional molecular-orbital theory has been used with considerable success to account for the loss of symmetry in the pi-electron spin density for compounds with a locked carbonyl group, and the calculated energy differences for the cis and trans isomers are in good agreement with experiment. Molecular-orbital calculations of spin densities were made for most of the radicals and comparisons are made with the predictions of valence-bond theory. The benzaldehyde, acetophenone, and 4-fluoroacetophenone anions have spectra with abnormally small ring-proton splitting constants. The appearance or nonappearance in all the radicals but these 3, of twofold symmetry in the pattern of splitting constants, is interpreted qualitatively in terms of competing effects determined by the order of the bond between the ring and carbonyl group, and steric factors in the neighborhood of the carbonyl group. A number of features of the experimentally determined spin density distributions have been correlated with the relative electron-with-drawing effects of the substituents. (Contractor's abstract)

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Columbia U. Dept. of Chemistry, New York.

ELECTRON SPIN RESONANCE OF ELECTROLYTICALLY GENERATED NITRILE RADICALS, by P. H. Rieger, I. Bernal and others. [1962] [11]p. incl. diagr. tables, refs. [AF 49(638)520] Unclassified

Presented at Delaware Valley Regional meeting of the Amer. Chem. Soc., Philadelphia, Pa., Jan. 26, 1962.

Published in Jour. Amer. Chem. Soc., v. 85: 683-693, Mar. 20, 1963.

Electron spin resonance spectra have been obtained for a series of anion radicals of aromatic and aliphatic nitriles. The radicals were generated by electrolytic reduction in N, N-dimethylformamide solution.

Polarographic investigations, both conventional and oscillographic, were also performed. In obtaining the ESR spectra, techniques were employed by which the starting material could be almost completely reduced to the radical, and thus the broadening of the lines in the spectra that arises from intermolecular electron exchange was largely eliminated. In most cases, a well-resolved ESR spectrum was obtained from the radical expected as the product of a simple reduction process, but in some reductions complex reactions took place. In a few reductions, unresolvable spectra, or no spectra at all, were obtained. Many of the radicals were stable for long periods of time (several hr or more), but a few decayed quite rapidly (a few min or less). Some of the compounds were reduced at potentials corresponding to several different polarographic waves and resulted in more than one type of radical from a single starting material. A number of reduction mechanisms were elucidated by a comparison of polarographic and ESR data. The majority of the spectra were completely interpreted and assignment of the splitting constants to the appropriate nuclei (H, N^{14}, N^{15}, C^{13}) in the molecule was possible. Qualitative observations of electron exchange reactions and of solvent effects were also made.

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Columbia U. [Dept. of Chemistry] New York.

OPTICAL AND ELECTRON SPIN RESONANCE SPECTRA OF AMMONIUM VANADYL TARTRATE (Abstract), by I. Bernal and P. H. Rieger. [1962] [1]p. [AF 49(638)-520] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 45, Jan. 24, 1962.

Ammonium vanadyl tartrate, a violet solid, was recently studied by Jorgensen as part of an optical investigation of vanadyl compounds. In contrast to the results obtained on most of these compounds, in which 2 or 3 bands are observed in the visible region, the tartrate gives 4. Jorgensen suggested, therefore, that the upper E state is split by a distortion of the ligand geometry to an approximate C_s configuration. The optical and ESR spectra of this material in aqueous solutions over a range of hydrogen ion concentrations was investigated. In concentrated HCl, the complex decomposes and one observes spectra that are the same as those of vanadyl chloride. As the acid concentration is lowered (pH = 1), new bands appear in the visible spectrum and finally (above pH = 3) the only species observed is that described by Jorgensen. The ESR spectrum of the aqueous solution of the violet compound shows 10 clearly resolved lines and a number of shoulders which can be readily interpreted as the superposition of 2 groups of 8 lines, each group arising from the splitting of the V nucleus (I = 7/2). The solution of the violet compound must therefore contain 2 distinct vanadyl ions in different environments.

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Columbia U. Dept. of Chemistry, New York.

SOLVENT EFFECTS IN ELECTRON SPIN RESONANCE SPECTRA, by J. Gendell, J. H. Freed, and G. K. Fraenkel. [1962] [10]p. incl. diagrs. tables, refs. (AF 49(638)520) Unclassified

Published in Jour. Chem. Phys., v. 37: 2832-2841, Dec. 15, 1962.

The purpose of this report is to assess the significance of solvent interactions, to determine under what circumstances they are likely to be appreciable, and to ascertain their effect on the theoretical interpretation of the spin-density distributions determined from ESR spectra. In Section II, the authors consider in a qualitative fashion how solvent interactions affect the hyperfine splittings and indicate why some splittings are much more strongly influenced than others. In Section III the dynamics of the exchange phenomena between different types of solvent-radical complexes are discussed, and it is shown how the splittings vary with the composition of mixed solvents. In Section IV, a simple model based on conventional molecular-orbital calculations is employed to account for the solvent variation of the pi-electron spin densities in the semiquinones. In the Appendix, the treatment of the exchange reaction by use of the modified Bloch equations is compared with the spectral density method. The contributions to the linewidths from random solvent interactions are also discussed.

676

Columbia U. Dept. of Chemistry, New York.

SOLVENT EFFECTS ON THE OPTICAL AND ELECTRON SPIN RESONANCE SPECTRA OF VANADYL ACETYLACETONATE, by I. Bernal and P. H. Rieger. [1962] [5]p. incl. diagrs. tables, refs. AF 49(638)-520] Unclassified

Published in Inorg. Chem., v. 2: 256-260, Apr. 1963.

The positions of certain bands in the optical absorption spectrum, as well as the vanadium nuclear hyperfine splitting constant in the ESR spectrum, of vanadyl acetylacetonate are found to be sensitive to changes in the solvent. The solvent effects on the optical spectrum are in good agreement with molecular orbital predictions of Ballhausen and Gray for vanadyl ion. The optical data may be used to calculate g-values in good agreement with the ESR results. A qualitative study of line widths in the ESR spectra shows that the anisotropy of the nuclear hyperfine interaction tensor also varies with changes in solvent. (Contractor's abstract)

677

Columbia U. Dept. of Chemistry, New York.

SPIN-DENSITY DISTRIBUTION IN NITRILE ANION RADICALS, by P. H. Rieger and G. K. Fraenkel. [1962] [16]p. incl. diagrs. tables, refs. (AF 49(638)-520) Unclassified

Published in Jour. Chem. Phys., v. 37: 2795-2810, Dec. 15, 1962.

Molecular-orbital calculations of the pi-electron spin densities in a series of aromatic and aliphatic nitrile anion radicals have been performed using the Hückel-LCAO method and the approximate configuration-interaction correction of McLachlan. Coulomb and resonance integrals for the nitrile group were estimated by comparing calculated spin densities with proton and C^{13} hyperfine splittings obtained from electron-spin resonance measurements. The predicted spin densities were in generally good agreement with the experimental results, but for some of the compounds it is impossible to get an exact fit between theory and experiment within the framework of the simple valence-theory calculations, if the sigma-pi interaction parameters relating splittings to spin densities are taken as fixed quantities. Semiempirical treatments of the N^{14} and C^{13} splittings in the cyano groups give excellent correlations of the experimental splittings with the calculated spin densities, and estimates have been made of some of the sigma-pi interaction parameters relating to the N^{14} splitting. Polarographic half-wave potentials have also been compared with calculated pi-electron energies. A discussion is given of the relation between the spin densities predicted by the valence-bond and molecular-orbital theories. (Contractor's abstract)

678

Columbia U. [Dept. of Chemistry] New York.

OPTICAL PUMPING AND CHEMICAL REACTIONS. by R. Bersohn, R. Bernheim, and R. [J.] McNeal. Final rept. Mar. 1, 1960-Feb. 28, 1962, 5p. (AFOSR-2608) (AF 49(638)785) Unclassified

An optical pumping apparatus was constructed for rubidium atoms. Measurements of the ribidium spin relaxation time were made and a theory developed of the relaxation process. Preliminary experiments on the kinetics of photolysis were unsuccessful because of the unexpectedly great reactivity of the photosensitive molecules with rubidium.

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Columbia U. Dept. of Chemistry, New York.

DISORIENTATION CROSS SECTIONS IN OPTICAL PUMPING, by R. J. McNeal. [1962] [2]p. incl. diagr. table. (AFOSR J183) (AF 49(638)785) AD 400071 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2726-2727, Dec. 1, 1962.

The disorientation cross sections and diffusion coefficients for rubidium atoms in methane, ethane, ethylene, cyclohexane, hydrogen, and nitrogen are given with applicable pressure ranges and temperature. The relaxation time was obtained at no fewer than 5 pressures for each gas, and at least 4 measurements were made at each pressure. The measurements of the relaxation time were reproducible to within 20% in most cases. The variation of σ (disorientation cross section) with the total number of buffer gas electrons for all gases reported to date is shown in graph form. Choosing this parameter as abscissa reveals the regular variation of σ rare-gas atomic number and the more irregular behavior observed with the other gases. The number of buffer gas electrons is not expected to be the only important parameter for description of the disorientation process.

680

Columbia U. Dept. of Chemistry, New York.

MICROWAVE SPECTRUM OF BROMOCYCLOBUTANE, by B. P. Dailey and W. G. Rothschild. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-J166) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)953 and National Science Foundation) AD 400098 Unclassified

Also published in Jour. Chem. Phys., v. 36: 2931-2940, June 1, 1962.

Rotational transitions of 4 isotopic species of bromocyclobutane have been observed. For $C_4H_7Br^{79}$, the rotational constants are A = 10 003.4 ± 13 mc, B = 1629.41 ± 0.03 mc, C = 1488.48 ± 0.03 mc; for $C_4H_7Br^{81}$, A = 10 002.6 ± 13 mc, B = 1615.14 ± 0.03 mc, and C = 1476.50 ± 0.03 mc. The values for the α-deuterated compound are, for $C_3H_6CDBr^{79}$, A = 9534.7 ± 13 mc, B = 1613.67 ± 0.03 mc, and C = 1486.24 ± 0.03 mc; for $C_3H_6CDBr^{81}$, A = 9533.4 ± 13 mc, B = 1599.55 ± 0.03 mc, and C = 1474.24 ± 0.03 mc. A set of structural parameters which reproduce these constants within 1.8 mc were obtained with an electronic computer: bond distances $C_\alpha - C_\beta$ = 1.540 ± 0.003A, $C_\beta - C_\gamma$ = 1.548 ± 0.003A, C—Br = 1.939A, C—H = 1.096A, and C—D = 1.087A; bond angles $C_\beta C_\gamma C_\beta$ = 88° 06′ ± 08′, $C_\beta C_\alpha C_\beta$ = 88° 41′ ± 08′, $HC_\gamma H$ = 110°44′, $HC_\beta H$ = 108°44′, $HC_\alpha Br$ = 111°, angle of $C_\beta C_\alpha C_\beta$ plane with C—Br = 131°00′ ± 08′, and dihedral angle = 29°22′ ± 08′ (the dihedral angle is the angle made by the normals of the $C_\beta C_\alpha C_\beta$ and $C_\beta C_\gamma C_\beta$ planes). The quadrupole-coupling constant of $C_4H_7Br^{79}$ along the C—Br bond direction is 512.2 ± 50 mc and the asymmetry parameter η_{bond} is -0.002 ± 0.014 mc. From frequency and intensity measurements of rotational satellites a low-lying vibrational mode was identified. Its effect is a displacement of all atoms in the molecule (out-of-plane bending). Its first and second excited states are 120 ± 25 and 251 ± 56 cm^{-1}, respectively, above ground level. The 3 lowest levels of the vibrational mode were shown to be large-amplitude vibrations of the molecule about a dynamical equilibrium dihedral angle of 25° to 29°. Highly excited vibrational states, which cause increasing planarity of the carbon ring, are expected to lead to

tunneling through the potential barrier to the less stable axial isomer of bromocyclobutane. The existence of the axial isomer by direct observation could not be established due to instrumental difficulties.

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[Columbia U. Dept. of Chemistry, New York]

VALENCE THEORY AND NUCLEAR RESONANCE, by J. F. Verdieck. Final rept. Nov. 13, 1962, 2p. (AFOSR-4051) (AF AFOSR-60-26) Unclassified

The applications of optical masers to problems in chemical physics are discussed. Principal among these applications is that of optical harmonic generation in high molecular weight polymers, such as DNA. Elementary calculations indicated that the angular distribution of the scattered harmonic light does not exhibit a functional form different from that of normal scattered light. Another application considered is that of double quantum absorption. A laser system was obtained to investigate the processes mentioned above. At the present time, efforts are being made to eliminate difficulties with the instrument.

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Columbia U. Dept. of Electrical Engineering, New York.

HYDROMAGNETIC KELVIN-HELMHOLTZ INSTABILITY SURFACE WAVES AND GEOMAGNETIC MICROPULSATIONS, by A. K. Sen. Final rept. June 15, 1962 [76]p. incl. diagrs. table, refs. (Rept. no. CU-20-62 AF350-EE) (AFOSR-2764) (AF 49(638)350) AD 283988 Unclassified

The most general form of hydromagnetic Kelvin-Helmholtz discontinuity in ideal incompressible fluids has been considered. The stability of the hydromagnetic flow of 2 uniform infinite streams with planar interface exhibiting this type of discontinuity has been analyzed in detail. Necessary and sufficient criteria for its stability have been obtained. A disturbance of the stable interface is seen to propagate as hydromagnetic surface waves. Instability of the interface leads to growing surface waves. These results are used to develop a new theory of geomagnetic micropulsations, in which the solar wind-exosphere interface is viewed as a surface of hydromagnetic Kelvin-Helmholtz discontinuity. It is shown that the sunlit side of this interface is unstable under most conditions of solar activity. Only during moderate and intense solar activity, the unstable waves thus generated may leave the interface along the lines of force of the earth's magnetic field and travel towards the earth's surface (in the Alfve'n mode) as micropulsations. Some of the important features of micropulsations, such as the bandwidth and higher occurrence frequency in the daylight hours and in the auroral zones, are explained by the theory. A critical examination of the single fluid approximations of the plasma equations has been made. A rigorous derivation of the boundary conditions in an ideal incompressible hydromagnetic fluid is also given. (Contractor's abstract)

683

Columbia U. Dept. of Electrical Engineering, New York.

CORRELATION FUNCTION AND POWER SPECTRA OF RADIO LINKS AFFECTED BY RANDOM DIELECTRIC NOISE, by D. S. Bugnolo. [1958] [4]p. incl. diagrs. refs. (Technical rept. no. T-3 Sup.: rept. no. CU-4-59AF350-EE) (AFOSR-3064) (AF 49(638)350) Unclassified

Also published in I. R. E. Trans. on Antennas and Propagation, v. AP-7: 137-141, Apr. 1959.

For abstract see item no. COU.21:003, Vol. II.

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Columbia U. Dept. of Electrical Engineering, New York.

PROCESS IDENTIFICATION IN ADAPTIVE CONTROL SYSTEMS, by S. C. Bigelow. Jan. 31, 1962 [14]p. incl. diagr. refs. (Technical rept. no. 73; rept. no. CU-7-62AF998-EE) (AFOSR-2274) (AF 49(638)998) Unclassified

A study of the shortcomings of an adaptive control system by Kalman is presented. A modification of the computational scheme permitting determination of the order of the plant characteristic equations and methods of eliminating undesirable characteristics of the system under steady-state conditions is given. It is shown that a time-domain characterization is better suited than plant frequency-domain to characterize the plant dynamics. Such a characterization is developed and presented in detail.

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Columbia U. Dept. of Electrical Engineering, New York.

CONTRIBUTIONS TO THE THEORY OF TIME-OPTIMAL CONTROL, by E. Kreindler. May 1, 1962 [60]p. incl. diagrs. refs. (Technical rept. no. 76) (AFOSR-2340) (AF 49(638)998) AD 282361 Unclassified

Also published in Jour. Franklin Inst., v. 275: 314-344, Apr. 1963.

A unified theory for the time-optimal control of general linear, not necessarily normal (a restriction usually imposed) plants, with generalized constraints on the control variable is developed. The approach is geometrical, thereby providing new insight and interpretation for some results obtained by methods of functional analysis. Some other known results are generalized and, as a rule, derived in a simpler fashion. The special cases of amplitude, energy, and area constraints are studied in detail, clarifying some points that remained hitherto obscure. An approximate synthesis procedure is proposed and an example is analyzed. (Contractor's abstract)

686

Columbia U. Dept. of Mechanical Engineering, New York.

PEIERLS STRESS FOR AN IDEALIZED CRYSTAL MODEL, by W. T. Sanders. [1962] [10]p. incl. diagrs. table, refs. (AFOSR-J42) (AF 49(638)909) AD 297112 Unclassified

Also published in Phys. Rev., v. 128: 1540-1549, Nov. 15, 1962.

An analytical investigation is made of the geometry of an edge dislocation in a simple atomic model of an infinite crystal, and the effect on the dislocation of externally applied shear stress. This study indicates that in dislocation theory significant results may be obtained from the discrete model, on which accurate analysis is possible. Even the simple model used here seems to be sufficiently realistic to yield meaningful results. The width, w of the dislocation, in this model, is proportional to γ^{-1}, where γ is the shear strength of a perfect crystal. The Peierls-Nabarro (P-N) stress has a large cyclic variation as γ is changed, but is proportional, in the average, to e^{-w}. This differs markedly from the result, $\sigma_{PN} \propto e^{-4\pi w}$, found from the continuum analysis. The values of the P-N stress ranged from 10^{-3} to 10^{-5}, in units of the shear modulus. In the analysis, the doubly infinite set of difference equations, derived from force balances on the atoms, is first reduced, by a type of Fourier series transform, to an infinite system of equations, which is then solved by the method of reduction. (Contractor's abstract)

687

Columbia U. Dept. of Mechanical Engineering, New York.

AN EXPERIMENTAL STUDY OF HEAT TRANSFER AT HIGH TEMPERATURE DIFFERENCES IN TURBULENT AIR FLOW BETWEEN A ROTATING CYLINDER AND A STATIONARY CONCENTRIC OUTER CYLINDER, by G. S. Longobardo and H. G. Elrod. Final rept. Aug. 1962, 327p. incl. illus. diagrs. tables, refs. (AFOSR-3207) (AF 49(638)1001) AD 407505 Unclassified

A study was made of convective heat transfer between a rotating cylinder and a stationary, concentric outer cylinder for the Taylor number range 2000 to 9000, and for rotor surface temperatures in the range 80° to 439°F. Measurements were made of over-all heat transfer, and velocity and temperature distributions in the gap between the 2 cylinders. A hot wire anemometer was used to determine whether secondary flows exist in the gap in the Taylor number range of the investiation. Principal results are given.

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Columbia U. [Dept. of Physics] New York.

[RADIO ASTRONOMY AT MILLIMETER WAVELENGTH] Final rept. Apr. 16, 1959-Apr. 30, 1962. 16p. incl. refs. (AFOSR-3201) (AF 49(638)631) AD 612131 Unclassified

A complete M-band radiotelescope was built for application of techniques of millimeter-band radioastronomy to studies of (1) behavior of oxygen in the earth's high atmosphere and (2) the precise frequency of the coronal radiation due to the hfs transition of sextuply ionized atomic nitrogen. The radiotelescope had an equatorial mount capable of steering a 180-lb, 5-ft parabolic antenna with a millimeter-band Dicke radiometer. The temperature of the high atmosphere to which the peak of the oxygen line is sensitive varied enough on different days to produce changes of oxygen absorption. Calculations also showed that if the temperature of the atmosphere was 260°K up to a height of 30 km and 240°K above 80 km, the ν_{27-} line would not be detectable by the radiotelescope used at that time. A millimeter-wavelength maser oscillator was constructed by using Fe^{3+} in rutile. The structure of the lowest energy levels of Fe^{3+} in rutile was accurately determined and the spin-lattice relaxation times and line width of some of the transitions were determined accurately.

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Columbia U. [Dept. of Physics] New York.

DETECTION OF THE MICROWAVE ν_{27-} LINE OF MOLECULAR OXYGEN PRODUCED IN THE HIGH ATMOSPHERE, by W. Kahan. [1962] [3]p. incl. diagrs. refs. (AFOSR-J85) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-50 and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78330]) AD 400457 Unclassified

Also published in Nature, v. 195: 30-32, July 7, 1962.

Radiotelescope observations of atmospheric absorption of solar millimeter wave radiation have resulted in the detection of the ν_{27-} telluric molecular oxygen line at 53,070 mc/s. Measurements made on different days have shown that the peak of the ν_{27-} molecular oxygen absorption varies in intensity, presumably as a result of temperature variations in the Earth's high atmosphere where the pressure is low enough to produce the line peak observed. The results of the experiments are discussed.

690

Columbia U. [Electronics Research Labs.] New York.

AN APPLICATION OF FUNCTIONAL ANALYSIS TO THE OPTIMAL CONTROL PROBLEM, by G. M. Krane and P. E. Sarachik. Jan. 22, 1962, 26p. incl. refs. (Technical rept. no. 72; rept. no. CU-6-62AF998-EE) (AFOSR-2102) (AF 49(638)998) Unclassified

In the classical formulation of the time optimal problem, an input signal is sought which causes the state of a dynamic system to change in the least time from its initial value to the final, desired one. It is assumed that this input signal is constrained by limitations imposed on its amplitude or energy, etc. Several different approaches, such as, variational techniques, dynamic programming,

or Pontryagin's maximum principle have been used to obtain the solution to this problem. The present paper presents yet another method which is applied to obtain generalization of the previously published results to the case of a time optimal nth order system with r inputs.

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Columbia U. [Electronics Research Labs.] New York.

ON OPTIMIZATION OF NONLINEAR DYNAMIC PROCESSES WITH UNKNOWN PA..METERS, by R. Kulikowski. Jan. 10, 1962 [27]p. incl. diagrs. refs. (Technical rept. no. 71; rept. no. CU-4-62AF993-EE) (AFOSR-2200) (AF 49(638)998) Unclassified

A class of non-linear, inertial and random plants which satisfy certain optimizability criterion is considered. Two different, convergent processes, the steepest descent and reducing transform methods, are constructed and compared. The notation of functional analysis is used.

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Columbia U. [Electronics Research Labs.] New York.

THE OTPIMUM CONTRC.. OF CROSS-COUPLED SYSTEMS, by P. A. Meschler. Mar. 1, 1962 [30]p. incl. diagrs. refs. (Technical rept. no. 75; rept. no. CU-8-62AF998-EE) (AFOSR-2312) (AF 49(638)998) Unclassified

The purpose of this paper is to develop a design technique for a cross-coupled controller, once the total system (total system referring to both plants) has reached the initial point on the trajectory. Requirements on the controller are: (1) it must maintain the total system on the trajectory, and (2) it must cause the total system to transverse the distance from some initial point to the final point on the trajectory in the least possible time while keeping within the constraints on the control variables.

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Columbia U. [Electronics Research Labs.] New York.

RESEARCH INVESTIGATION IN CONTROL SYSTEMS, by G. M. Kranc. Final rept. Dec. 1, 1960-May 31, 1962. Sept. 1962, 9p. (Rept. no. CU-4-62AF998-EE) (AFOSR-4217) (AF 49(638)998) AD 293275 Unclassified

Abstracts of 5 reports in the field of control systems theory are given. These are: (1) a class of nonlinear, inertial and random plants which satisfy certain optimizability conditions; (2) the optimal time problem solution which is extended to time-varying plants with r inputs and m outputs; (3) a method for obtaining the order of the system characteristic equation from observation of input-output data; (4) techniques for interrelating the inputs to two separate dynamic systems when it is required that the output of each satisfy a functional relationship; and (5) a unified theory for the time-optimal control of general, linear, not necessarily normal plants, with generalized constraints on the control variable.

694

Columbia U. Electronics Research Labs., New York.

ULTRASONIC DELAY LINE DEVELOPMENT, by L. B. Lambert. Technical progress rept. July 1-Dec. 31, 1961. Jan. 2, 1962, 43p. incl. diagrs. refs. (Technical rept. no. P-1/178; rept. no. CU-1-62AF1113-ERL) (AFOSR-1905) (Sponsored jointly by Advanced Research Projects Agency, Air Force Office of Scientific Research under AF 49(638)1113, and Rome Air Development Center) AD 271710 Unclassified

Progress on ultrasonic delay line research is discussed. The results of a continued study of lead as a bonding and backing material for ultrasonic delay lines are presented. The triple-travel response level was reduced below the level of spurious responses due to diffraction for a majority of delay line applications. The results of an investigation of the diffraction field, in a solid medium, of an ultrasonic transducer are presented. The experimental results indicated that the assumptions made in the mathematical description of acoustic diffraction phenomena are valid. Design techniques for polygonal delay lines are discussed in terms of spurious response levels. A theoretical analysis, based on Fresnel diffraction theory, is presented, which results in the determination of the optimum transducer length for minimum spurious response level. (Contractor's abstract, in part)

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Columbia U. Electronics Research Labs., New York.

TWO-DIMENSIONAL FILTERING (Unclassified title), by L. B. Lambert. Technical progress rept. July 1-Dec. 31, 1961. Jan. 2, 1962, 66p. incl. illus. diagrs. refs. (Technical rept. no. P-1/179; rept. no. CU-2-62AF1113-ERL) (AFOSR-1912) (Sponsored jointly by Advanced Research Projects Agency, Air Force Office of Scientific Research under AF 49(638)1113, and Rome Air Development Center) AD 329253 Confidential

A summary review of the theory and experimental results for the electro-optical, 2-dimensional filter is presented for the convenience of the reader. The measured characteristics of the 6-in. water delay line system are used in typical examples. By employing a ruby optical maser as a light source for the coherent optical system, frequency and time resolutions were measured. For a linear, frequency modulated input signal having a duration of 100 μsec and a bandwidth of 10 mc, a frequency resolution of 13 kc and a time (range-delay) resolution of better than 0.15 μsec were obtained. Progress is also reported concerning the implementation of the improved 4-lens, diffraction limited system which has been designed to increase the integration efficiency and dynamic range for a time-bandwidth product of 1000. (Unclassified)

696

Columbia U. Electronics Research Labs., New York.

COMPUTING TECHNIQUES, by J. Dutt, S. Rabinowitz, and M. Shapiro. Technical progress rept. July 1-Dec. 31, 1961. Jan. 2, 1962, 78p. incl. diagrs. tables, refs. (Technical rept. no. P-1/180; rept. no. CU-3-62AF1113-ERL) (AFOSR-1913) (Sponsored jointly by Advanced Research Projects Agency, Air Force Office of Scientific Research under AF 49(638)1113, and Rome Air Development Center) AD 271707 Unclassified

A 2-stage signal processor which may be used to process the received waveform from a large time bandwidth radar transmission is described. This 2-stage receiver concept combines the advantages of the high speed capability of analog equipment and the versatility of digital equipment. It is applicable to a wide variety of transmitted waveforms which may be approximated by a sequence of discrete frequency components. The capability of this 2-stage signal processor to resolve multiple closely spaced (in range) targets is demonstrated and the influence of target motion and receiver noise are examined. Two convenient approximations having good accuracy in the probability range of interest are described and compared numerically with results known to be exact. (Contractor's abstract)

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Columbia U. Electronics Research Labs., New York.

DATA PROCESSING TECHNIQUES, by M. Shapiro and S. Wissner. Final rept. Oct. 1, 1961-June 30, 1962, 192p. incl. illus. diagrs. tables, refs. (Rept. no. F 180; rept. no. CU-8-62AF1113-ERL) (AFOSR-2916) (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under AF 49(638)1113) AD 295618 Unclassified

A 2-stage receiver structure which may be used to process the received waveform from a general class of high time-bandwidth product radar transmissions is described. It is shown that the first stage of the receiver which processes individual spectral components of the received signal can be readily implemented. Several methods of implementing the second stage of the receiver, called a waveform processor, are outlined. The results of various analytical studies, which serve to evaluate the performance and substantiate the feasibility of this receiver concept, are also presented. (Contractor's abstract)

698

Columbia U. Electronics Research Labs., New York.

STABILITY OF HYDROMAGNETIC KELVIN-HELMHOLTZ DISCONTINUITY, by A. K. Sen. [1962] [10]p. incl. diagrs. refs. (AFOSR-5508) (AF 49(638)350 and AF 49-(638)1113) Unclassified

Also published in Phys. Fluids, v. 6: 1154-1163, Aug. 1963.

The most general form of hydromagnetic Kelvin-Helmholtz discontinuity in ideal incompressible fluids has been considered. The presence of surface tension on the surface of discontinuity and gravity is also assumed. The stability of the hydromagnetic flow of 2 uniform infinite streams with planar interface exhibiting this type of discontinuity, has been analyzed in detail. Two necessary and sufficient criteria for its stability have been obtained, in contrast to only one that is usually given. The stabilizing effect of magnetic field is strongly dependent on its discontinuity at the interface and its orientation relative to that of streaming. The consideration of the stability to a single mode of perturbation leads to the conclusion that this is dependent on the above mentioned factors, as well as the following ones. The effect of surface tension and gravity is dependent on the wavelength, while that of the magnetic field is dependent on the direction of propagation of perturbation. (Contractor's abstract)

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Columbia U. Electronics Research Labs., New York.

THE EIGENVALUES OF HILL'S EQUATION, by L. E. Blumenson. June 15, 1962, 41p. incl. refs. (Technical rept. no. T-1/180; rept. no. CU-6-62AF1113-ERL) (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under AF 49(638)1113) AD 295616 Unclassified

Restrictions for the eigenvalues of Hill's equation have been found by Liapunoff, Borg and others. It is shown here that they can assume certain extreme values only if Hill's equation reduces to a trivial case. Effective iteration schemes for the computation of the first eigenvalue and the corresponding eigensolution are derived. All eigenvalues are expressed as an infimum of an integral, with very simple side conditions involving the zeros of a corresponding eigensolution, and bounds for the eigenvalues are then obtained. The case of equally spaced zeros is investigated in detail, and again it is shown that certain extremal cases can occur only if the differential equation is of a trivial type. (Contractor's abstract)

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Columbia U. Electronics Research Labs., New York.

ELECTRO-OPTICAL TRANSFER CHARACTERISTICS OF LIQUID DELAY-LINE LIGHT MODULATORS, by M. Arm, L. B. Lambert, and B. Silverberg. [1962] [11]p. incl. diagrs. [AF 49(638)1113] Unclassified

Presented at 1962 I. R. E. Internat'l. Convention, Mar. 26-29, 1962, New York.

Abstract published in Proc. Inst. Radio Engineers, v. 50: 345, Mar. 1962.

Published in I. R. E. Internat'l. Convention Record, Pt. 6: 79-89, 1962.

The Debye-Sears effect in a water delay line is utilized to obtain spatial light modulation in real time. The

design, implementation, and measurement techniques which have been employed to optimize the electro-optical transfer characteristic of this light modulator are presented. Insertion loss, bandwidth and phase response are theoretically determined for the case of the back-loaded transducer and the case of the quarter-wave matching section. These results are then compared with corresponding experimental results. It is shown that a low insertion loss can be obtained with a 50% bandwidth by employing a quarter-wave matching section technique. Techniques which have been successful in producing quarter-wave matching sections 30μ thick adhered to 20-mc, transducers, are described and experimental results are presented. (Contractor's abstract)

701

Columbia U. Electronics Research Labs., New York.

A NOTE ON INPUT-OUTPUT SPECTRAL DENSITIES, by K. S. Miller. [1962] [4]p. (AF 49(638)1113) Unclassified

Published in Quart. Appl. Math., v. 21: 249-252, Oct. 1963.

This note derives a variant on the well known formula by which the power spectral density of the output of a stationary linear system can be obtained from that of the input and the frequency response of the system. The variant applies to a situation in which the input is a stationary random process (possessing a power spectral density) multiplied by a finite Fourier series. Such situations are encountered in communications engineering. (Math. Rev. abstract)

702

Columbia U. Electronics Research Labs., New York.

SEQUENTIAL DESIGN OF EXPERIMENTS WITH TWO RANDOM VARIABLES, by L. R. Abramson. Sept. 20, 1962, 107p. incl. refs. (Technical rept. no. T-2/180; rept. no. CU-7-62AF1113-ERL) (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under AF 49(638)1113) AD 295617 Unclassified

Given 2 independent random variables with densities f_1 and f_2 the following hypotheses are tested, H_1: $f_1 = f_{11}$, $f_2 = f_{12}$ vs H_2: $f_1 = f_{21}$, $f_2 = f_{22}$, where the f_{ij} $(i, j = 1, 2)$ are known densities. Bayes sequential procedures are studied and proof presented to show that a Bayes a Bayes decision rule always exists. The asymptotic case where the cost of each observation approaches zero is considered. An asymptotic expression for the Bayes risk is found and necessary and sufficient conditions for a decision rule to be asymptotically Bayes are derived. The properties of a class of tests called tandem tests are studied and necessary and sufficient conditions found for a tandem test to be asymptotically Bayes. (A tandem test is a sequence of at most 2 Wald tests, the first performed on one of the random variables and the second (which may depend on the outcome of the first) performed on the other.) (Contractor's abstract)

703 Columbia U. Electronics Research Labs., New York.

WIDE-BAND, INSTANTANEOUS SPECTRUM ANALYZERS EMPLOYING DELAY-LINE LIGHT MODULATORS, by L. B. Lambert. [1962] [10]p. incl. diagrs. refs. [AF 49(638)1113] Unclassified

Presented at 1962 I. R. E. Internat'l. Convention, Mar. 26-29, 1962, New York.

Abstract published in Proc. Inst. Radio Engineers, v. 50: 345, Mar. 1962.

Published in I.R.E. Internat'l. Convention Record, Pt. 6: 69-78, 1962.

Fast-acting spectrum analyzers which provide a large number of resolution elements covering a large frequency band are synthesized by suitably combining ultrasonic, electronic, and optical techniques. The Debye-Sears effect in a transparent, ultrasonic delay line is utilized to convert an electrical input signal to a proportional spatial pattern. This pattern modulates coherent light which is then spatially integrated by a lens configuration. The Fourier transform of the input signal is obtained as a distribution of light amplitude in the focal plane of the integrating lens. The realizable frequency coverage, number of resolution elements, and dynamic range are discussed. Adaptation techniques are described and typical results are presented which indicate the improvement that can be obtained by employing an optical maser as a light source. (Contractor's abstract)

704

Columbia U. [Inst. of Air Flight Structures] New York.

ON THE BUCKLING OF CIRCULAR CYLINDRICAL SHELLS UNDER EXTERNAL PRESSURE, by A. E. Armenakas and G. Herrmann. Aug. 1962 [16]p. incl. diagrs. refs. (Technical note no. 7; rept. no. CU-23-62AF430-CE) (AFOSR-3868) (AF 49(638)430) AD 612674 Unclassified

A general bending theory of circular cylindrical shells under the influence of initial stress, established recently by the authors, is employed in re-examining the buckling of such shells under external pressure, and the results are compared to those of previous investigations. Simple but accurate expressions for the buckling pressure applicable to a wide range of shell dimensions are presented. (Contractor's abstract)

705

Columbia U. [School of Engineering] New York.

DEFORMATION AND FRACTURE OF POLYCRYSTALLINE CADMIUM, by N. S. Stoloff and M. Gensamer.

[1962] [11]p. incl. illus. diagrs. tables, refs. (AFOSR-J164) (AF 49(638)406) AD 400088 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 227: 70-80, Feb. 1963.

The effects of temperature, grain size, and magnesium content on the strength and ductility of cadmium were studied in the range -269° to 23°C. A sharp drop in ductility between -140° and -190°C marked a transition in fracture mode from ductile shear to intergranular fracture. The addition of up to 15.35 wt % Mg in solid solution raised the transition temperature, and for 2 compositions produced basal cleavages. The relatively high ductility of unalloyed cadmium at cryogenic temperatures is attributed to temperature independence of the yield stress and the absence of dislocation locking. (Contractor's abstract)

Committee on Mathematical Biology, Chicago, Ill.
see Chicago U. Committee on Mathematical Biology, Ill.

706

[Communication Research Inst., Miami, Fla.]

INTERSPECIES COMMUNICATION, by J. C. Lilly. [1962] [3]p. incl. illus. (AFOSR-2623) [AF AFOSR-61-62] Unclassified

Also published in McGraw-Hill Yearbook of Sci. and Tech., 1962, p. 279-281.

The suitability of the bottle-nosed dolphin (Tursiops truncatus) for verbal interspecies communication research is discussed. Exchanges between individuals of the species in which each animal transmits and then waits for the transmission from the other animal have been found. Alternations between 2 individuals seem to be the rule for the whistles and clicks emitted by the animals. Tursiops emits high-pitched sounds which have been variously described as quacks, squawks, wails, bleats, barks, and buzzings. The tendency of some of the species to produce many humanoid sounds while hearing human speech has been interpreted as mimicking. Neurophysiological studies of the dolphin's brain reveals some similarity to the human one (as opposed to smaller-brained animals) with respect to vast silent areas, a restricted motor strip which causes muscle movements when stimulated and large and well-differentiated areas for eye movement.

707

Communication Research Inst., Miami, Fla.

OPERANT CONDITIONING OF THE BOTTLENOSE DOLPHIN WITH ELECTRICAL STIMULATION OF THE BRAIN, by J. C. Lilly and A. M. Miller. [1961] [7]p. incl. illus. diagrs. refs. (AFOSR-2624) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-62, National Institutes of Health, and Office of Naval Research) AD 612326 Unclassified

Also published in Jour. Compar. and Physiol. Psychol., v. 55: 73-79, Feb. 1962.

It is shown that it is feasible to place electrodes into the large brain of the w[illegible]sthetized bottlenose dolphin (Tursiops truncatus). Using roving electrodes, one can demonstrate separate zones of the brain which are positively and negatively reinforcing, i.e., in which 'self-start' and 'self-stop' activity can be elicited. It is shown that the dolphin learns these tasks more rapidly than does the monkey. It is also shown that in a rewarding or positively reinforcing zone, the animal tends to vocalize in complex and startling ways. It vocalizes when first stimulated in this area or when stimulation is withdrawn after a period of 'self-start' activity. Thus, it is concluded that the behavior of the bottlenose dolphin differs from that of the monkey in the following respects: Like the monkey, the dolphin uses any available external somatic motor output in order to push switches to stimulate its own brain for a wanted, or positive, or rewarding stimulus or to cut off an unwanted, or negative, or punishing stimulation started by the apparatus. In contrast with the monkey, the dolphin uses its vocal output when this is effective in order to modify the responses obtained from the environment (in terms of brain stimulation). The dolphin can inhibit violent escape behavior caused by 'punishing' brain stimulation; the macaque does not.

708

Communication Research Inst., Miami, Fla.

VOCAL BEHAVIOR OF THE BOTTLENOSE DOLPHIN, by J. C. Lilly. [1962] [10]p. incl. illus. diagr. refs. (AFOSR-J207) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-62], Coyle Foundation, National Institutes of Health, National Science Foundation, Office of Naval Research, and Office of Science of the Department of Defense) AD 400179 Unclassified

Also published in Proc. Amer. Philos. Soc., v. 106: 520-529, Dec. 1962.

The bottlenose dolphin (Tursiops truncatus Montagu) emits several different classes of complex sounds. Some of these sounds are encountered in the natural state, others are acquired during long periods of captivity in close contact with scientific investigators. Some of these sounds are emitted under water without loss of air, others are emitted in air with the open blowhole above the water. The naturally occurring underwater sounds consist of several classes including whistles, clicks, barks, creakings, etc. All of these sounds are relatively high pitched compared to those of the human voice and extend from 2 kcps to approx 150 kcps. When a dolphin opens its blowhole and emits these sounds, the characteristics frequencies heard are lower than those heard simultaneously under water. A dolphin can be induced by various means to emit another class of sounds in air. Because of their resemblance to the sounds of human speech these sounds have been named "humanoid emissions." Analysis by means of the sound spectrograph and oscillographic methods demonstrates that these sounds are basically white-noise-hissings and/or high-pitched buzzings, modulated in selective frequency bands by the efforts of the animal.

709

Connecticut U. [Dept. of Mathematics] Storrs.

INTEGRAL NORMS OF SUBADDITIVE FUNCTIONS, by R. P. Gosselin. [1962] [5]p. (AFOSR-J861) (AF 49-(638)608) AD 416017 Unclassified

Also published in Bull. Amer. Math. Soc., v. 69: 255-259, Mar. 1963.

The fact that certain integral norms for positive, measurable, subadditive functions of a single real variable are comparable is here extended to functions on Euclidean n-space E^n. It is shown also that an integral norm taken over E^n is equivalent to one taken over one-dimensional space, and thus n-dimensional analogues of inequalities for one dimension are obtained. Let σ be positive, measurable, and subadditive on E^n, $n > 1$, let $\omega_1, \omega_2, \ldots, \omega_n$ be linearly independent unit vectors, and let $0 < p < \infty$ and $\sigma p > -1$. Then there exist constants A and B, depending only on σ, p, and n, such that

$$\int_{E^n} \frac{\sigma^p(x)}{|x|^{n+p\sigma}}dx \leq A \sum_{i=1}^{n} \int_{E^1} \frac{\sigma^p(r\omega_i)}{|r|^{1+p\sigma}}\,dr \leq B \int_{E^n} \frac{\sigma^p(x)}{|x|^{n+p\sigma}}dx.$$

The restriction $\sigma p > -1$ can be omitted for the second inequality. (Math. Rev. abstract)

710

Connecticut U. [Dept. of Mathematics] Storrs.

ON THE L^p THEORY OF CARDINAL SERIES, by R. P. Gosselin. [1962] [15]p. (AFOSR-64-0208) [AF AFOSR-62-142] AD 432691 Unclassified

Also published in Ann. Math., v. 78: 567-581, Nov. 1963.

Let R^k be k-dimensional Euclidean space, and let $K(x) \in L^2(R^k)$ be such that $|K(x+m)|_{-\infty}^{\infty}$ is a complex orthonormal set. The author shows that this is equivalent to the condition $\Sigma_n |K^\wedge(x+2\pi n)|^2 = (2\pi)^{-k}$ for almost all x, the summation being taken over all integral lattice points $n = (n_1, \ldots, n_k)$ in R^k. Let T_K be the closure in $L^2(R^k)$ of this orthonormal set. If $F \in T_K$ then, in $L^2(R^k)$, $F(x) = \Sigma_m a_m K(x+m)$, where $a_m = \int_{R^k} F(x)\overline{K(x+m)}dx$. (Actually, much more can be said about the mode of convergence of this series.) T_K is said to be translation-invariant if $F(x) \in T_K$ implies $F(x-a) \in T_K$ for all $a \in R^k$. It is shown that T_K is translation-invariant if and only if every $F \in L^2(R^k)$ such that supp $F \subset$ supp K belongs to T_K, and that both of these conditions are equivalent to $|K^\wedge(x)| = (2\pi)^{-k/2}$ on supp $K^\wedge$. Moreover, in this case, if $f \in T_K$ then $\Sigma_m F(x+m)\overline{K(x+m+n)} = a_n$ a.e., and $\Sigma_m |F(x+m)|^2 = \Sigma_m |a_m|^2$ a.e. In the concluding pages of this paper the author considers l^p analogues of these l^2 results. Let $k = 1$ and let supp $K \subset [-\pi, \pi]$. Then $K^\wedge(x)$ can be written in the form $(2\pi)^{-1/2}e^{ig(x)}$, g real, for $x \in [-\pi, \pi]$. Assume now, in addition, that g(x) is of bounded total variation on $[-\pi, \pi]$. Let $1 < p < \infty$. If $\Sigma_m |a_m|^p < \infty$, then the series $\Sigma_m a_m K(x+m)$ converges everywhere to a function F(x) which satisfies $\|F(x)\|_p \leq C(\Sigma_m |a_m|^p)^{1/p}$ for some constant C. Conversely, if $F \in T_K^p$, the closure in $L^p(R^1)$ of $\{K(x+m)\}_{-\infty}^{\infty}$, and if $a_m = \int F(x)\overline{K(x+m)}\,dx$, then $(\Sigma_m |a_m|^p)^{1/p} \leq C' \|F(x)\|_p$ and $\Sigma_m a_m K(x+m)$ converges a.e. to F(x). Moreover, $a_n = \Sigma_m F(x+m)\overline{K(x+n+m)}$ a.e. (Math. Rev. abstract)

711

Copenhagen U. [Dept. of Chemistry] (Denmark).

PREPARATION OF ^{18}O-LABELLED FURAN, by B. Bak, J. T. Nielsen, and M. Schöttlander. [1962] [1]p. (AFOSR-3808) [AF 61(052)73] Unclassified

Also published in Acta Chem. Scand., v. 16: 771, 1962.

3-Bromocoumalic acid Me ester (I) (1.10 g), disolved in a solution of 2.20 g KOH in 4.55 g H_2O (enriched to 32% in O^{18}), the mixture refluxed 20 min under dry N at 120°, cooled to liquid air temperature, and treated in vacuo with 44 mmol dry HCl gas, the temperature of the mixture slowly elevated while it was magnetically stirring, stirring continued at room temperature 30 min, and the mixture evaported in vacuo at room temperature (HCl, H_2O, and MeOH collected in trap 1) gave 2,4-furandicarboxylic acid O-labeled in the hetero O and the carboxyl groups as a residue (together with KBr and KCl). Conversion of this acid to furan-O^{18} (II) was carried out as previously (item no. 597, Vol. V), except the heating was for 1 hr at 250-275°. After cooling, the CO_2 evolved was removed at -80° in vacuo and collected at liquid air temperature (trap 2). The yield of II was 26%, based on I; infrared and microwave gas-spectra showed II contained 25% O^{18}. Mass spectroscopy showed the contents of trap 1 had about the same O^{18}-abundance as II, but that of trap 2 had about half this value; these data indicate that the carbonyl O of the labeled diacid was not exchanged against O^{18}. Introduction of O^{18} into the the 2 CO_2H groups of the diacid took place during the saponification of the carbomethoxy and lactone groups.

712

Copenhagen U. Inst. of Neurophysiology (Denmark).

SINGLE UNITS IN MONKEY (MANGABEY) CORTEX WITH NARROW SPECTRAL RESPONSIVENESS, by M. A. Lennox-Buchthal. [1962] [27]p. incl. illus. tables. (AFOSR-369) (AF 61(052)189) Unclassified

A single unit study was carried out in the visual cortex of anesthetized mangabey monkeys. The stimuli were 20 msec flashes through broad pass filters and, in some instances, electric stimulation of the optic nerve. The units which responded are described and the effect of varied background light studied.

713

Copenhagen U. Inst. of Neurophysiology (Denmark).

SOME FINDINGS ON CENTRAL NERVOUS SYSTEM ORGANIZATION WITH RESPECT TO COLOR, by M. A. Lennox-Buchthal. [1960] [6]p. incl. illus. diagrs. refs. (AFOSR-714) (AF 61(052)189) AD 632073 Unclassified

Also published in The Visual System: Neurophysiology and Psychophysics; a Symposium, Freiburg (Germany) (Aug. 28-Sept. 9, 1960), ed. by R. Jung and H. Kornhuber. Berlin, Springer-Verlag, 1961, p. 191-196.

Evidence is reviewed that reorganization of visual messages with respect to color occurs in the central nervous system. In man, cat-fish and cat blue and red stimuli of equal brightness appear to undergo temporal differentiation in that red stimuli are transmitted more rapidly than blue. This has not been confirmed for monkeys. In monkey cortex (the eye light adapted) more than half the single units responding to light did so with narrow spectral responsiveness. Different units responded to flashes through only 1 of 4 broad pass filters peaked at 450, 515, 587 or > 600 mμ. All single units with narrow spectral responsiveness to 560 mμ responded as well to 1 or 2 adjacent filters. The response of the same cells to optic nerve stimulation suggested that they lay on a one to one pathway from optic nerve to cortex. The different experimental conditions from those used in studies of monkey geniculate do not appear sufficient to explain the difference in results. It seems likely that the information available to single cortical cells is different from that at geniculate and that it is simpler. (Contractor's abstract)

714

Copenhagen U. Inst. of Neurophysiology (Denmark).

RESPONSES OF SINGLE CORTICAL CELLS OF MONKEY TO MONOCHROMATIC FLASHES, by M. [A.] Lennox-Buchthal. Jan. 1962 [7]p. incl. diagrs. (Technical note no. 3) (AFOSR-2505) (AF 61(052)189) AD 280014 Unclassified

In an attempt to elucidate the role of the central nervous system and especially of the cortex in color vision, a study was carried out on monkeys to ascertain whether or not single cortical cells respond selectively to different colors. The results are discussed relative to the following theories of color vision: Is color vision trichromatic as postulated by Young and Helmholtz depending on 3 primary colors, or is it trichromatic depending on color pairs of which one is white-black as postulated by Hering? No single units were found which responded to white but not to colors, excluding, it would seem, this portion of the Hering theory. Some single cells responded to blue, green or red in agreement with the trichromatic theory, but the precise limits of the response range were variable from cell to cell and from time to time for each cell. On the other hand, certain other single cortical cells responded to color pairs, sometimes to roughly complementary colors and then often to white, sometimes to colors not complementary (green and red) and then not to white. It would appear that there may be several mechanisms for color vision, as proposed by the theory of von Kries.

715

Cork U. Coll. (Ireland).

RESEARCH ON AEOLOTROPIC ELASTICITY AND PLATES, by P. M. Quinlan. Final rept. Dec. 1, 1960-Nov. 30, 1961 [2]p. (AFOSR-2489) (AF EOAR-61-4) AD 279903 Unclassified

Three technical notes issued under the contract during this period are briefly described. (See item no. 601, Vol. V; and item nos. 716 and 717, Vol. VI.)

716

Cork U. Coll. (Ireland).

THE λ-METHOD FOR AEOLOTROPIC RECTANGULAR AND SKEW PLATES, by P. M. Quinlan. Apr. 1962, 37p. incl. diagrs. table. (Technical note no. 15) (AFOSR-2683) (AF EOAR-61-4) AD 275841 Unclassified

A simplified derivation of the basic equations of aeolotropic elasticity, with at least one plane of symmetry, is presented. A solution to the concentrated load case, the Green's function of the problem, is obtained involving double Fourier series, which are then summed to a pair of singly infinite series. The necessary calculus for integration and differentiation is established leading to particular integrals for line and distributed loadings and also for concentrated moments, and for all derived functions (slopes, moments, shears) of these loadings. Singly infinite series of complementary functions are then obtained, a great effort being made to simplify and coordinate the resulting algebraic formulas with the maximum use of algebraic symmetry. Complementary functions for all boundary conditions are reduced to a general form, wherein they are specified by 2 parameters q' and q, and 2 corresponding sets of functions $h_q(s)$ and $f_q(s)$. On equating like harmonics on the boundaries, a general truncated set of simultaneous equations is obtained that is readily adapted to all loadings and all boundary conditions. These can be generated and solved in an electronic computer. Finally,

extension is made to the case of an aeolotropic skew plate, which is reduced to the same algebraic form as that for the rectangular plate. (Contractor's abstract)

717

Cork U. Coll. (Ireland).

AN AXIALLY-SYMMETRIC AEOLOTROPIC MEDIUM, by P. M. Quinlan. Mar. 1962, 65p. incl. diagrs. tables, refs. (Technical note no. 14) (AFOSR-2689) (AF EOAR-61-4) AD 275842 Unclassified

The study is in 2 parts, the first dealing with plane strain problems in a semi-infinite and in an infinite aeolotropic medium which is transversely isotropic. The second part deals with axially-symmetric loadings in the same media. Solutions are presented for line and point loads normal to the surface of a semi-infinite body, for loads at an interior point of such a body, and for Kelvin's problem in an infinite body. Image systems are developed and applied to give relaxation type solutions to an aeolotropic layer on a rigid base, and to multi-layer systems. (Contractor's abstract)

718

Cork U. Coll. (Ireland).

THE λ-METHOD FOR SKEW PLATES, by P. M. Quinlan. [1962] [18]p. incl. diagr. table. (AFOSR-4224) (AF EOAR-61-4) AD 431130 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. 2: 733-750, 1962.

A comprehensive method of setting up the skew-plate problem, under all boundary conditions and loadings, is presented. The results, for the concentrated load case, are given in the form of a single infinite series involving root functions. The necessary calculus for differentiating and integrating these functions is then established, leading to the deduction of the distributed load whether distributed over a line or over a parallelogram similar to the plate. By treating a concentrated moment as a force pair, this case follows by differentiation of the concentrated load case. Finally, the boundary conditions are reduced to a truncated set of simultaneous equations, which can be programmed for solution on an electronic computer. (Contractor's abstract)

719

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

CATALYTIC SURFACE RECOMBINATION IN BOUNDARY-LAYER PROFILES OF THE FALKNER-SKAN TYPE, by W. J. Rae. Sept. 1962, 58p. incl. diagrs. tables, refs. (Rept. no. AF-1412-A-1) (AFOSR-2071) (AF 49(638)782) AD 288024 Unclassified

Reactant concentrations in the diffusion-controlled flow over a surface of constant catalycity are calculated for the Falkner-Skan family of profiles. The heat release due to surface recombination is found to be insensitive to the pressure gradient when the wall is relatively non-catalytic; for catalytic walls a decreasing pressure gradient (i.e., more strongly accelerated flow) tends to increase the heat transfer. (Contractor's abstract)

720

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

TRANSIENT HEAT-TRANSFER MEASUREMENTS OF CATALYTIC RECOMBINATION IN A STEP-FUNCTION FLOW OF ATOMIC OXYGEN, by A. L. Myerson. Interim rept. Aug. 1962 [33]p. incl. illus. diagrs. refs. (Rept. no. AF-1412-A-2) (AFOSR-3203) (AF 49(638)-782) AD 412362 Unclassified

Heat transfer measurements were made by means of thin-film resistance thermometry which show simultaneously, catalytic and noncatalytic transient heating. These transients are observed with msec resolution during a well-defined step-function of atomic oxygen concentration in a subsonic flow. The differences are observable because of the short response time of the probe and are thus in significant contrast with the behavior determined by the extant steady-state techniques. Differences in the behavior of the heat-transfer rate as a function of time are noted for conditioned and unconditioned surfaces. (Contractor's abstract)

721

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SILVER-CATALYZED SURFACE RECOMBINATION IN A STEP-FUNCTION FLOW OF ATOMIC OXYGEN, by A. L. Myerson. [1962] [3]p. incl. diagrs. refs. (AFOSR-64-0140) (AF 49(638)782) AD 431070 Unclassified

Also published in Jour. Chem. Phys., v. 38: 2043-2045, Apr. 15, 1963.

The heating of a Ag film was determined as a function of time prior to and following the arrival of atomic oxygen at the film. The rate of heating of a film never before exposed to atomic oxygen was much less in the early stages, and no sudden jump in temperature was observed upon arrival of atomic oxygen as in the case of films previously exposed to oxygen. The usual rise in temperature did not occur until approximately 65 msec after the arrival of atomic oxygen. Metallic Ag was essentially noncatalytic to oxygen atomic recombination. The high catalytic activity was attributed to Ag oxide.

722

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

CATALYSIS OF RECOMBINATION IN NONEQUILIBRIUM NOZZLE FLOWS, by A. Q. Eschenroeder and J. A. Lordi. [1962] [16]p. incl. diagrs. tables, refs. (Sponsored jointly by [Air Force Office of Scientific Research

under AF 49(638)782] and National Aeronautics and Space Administration) Unclassified

Published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962) New York, Academic Press, 1963, p. 241-256.

The effects of a chemically active additive were investigated for nonequilibrium expansions of a dissociating gas. Numerical solutions were obtained in order to assess the catalytic influence of free radicals formed by bonding between the additive element and atoms of the dissociating gas. High-enthalpy nozzle flows of hydrogen with small quantities of carbon addition were studied over a range of equilibrium reservoir conditions appropriate to nuclear and electrothermal rocket operation. A chemical kinetic model consisting of 8 species and 12 reaction steps evolved from studies of composition histories based on various finite-rate reaction schemes. Through 2-body abstraction and association reactions between hydrogen atoms and hydrocarbon species, more of the energy in hydrogen dissociation is released than would kinetically be available in the absence of carbon. In some cases, this effect counterbalances the increased molecular weight so that the specific impulse of the system exceeds that of pure hydrogen in finite-rate nonequilibrium flows. (Contractor's abstract)

723

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

COMPARISON OF EXACT AND APPROXIMATE SOLUTIONS FOR NONEQUILIBRIUM NOZZLE FLOWS, by J. A. Lordi. [1962] [2]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)782 and National Aeronautics and Space Administration) Unclassified

Published in ARS Jour., v. 32: 1235-1236, Aug. 1962.

The nonequilibrium expanding flow of a chemically reacting mixture is a problem of current interest in connection with high enthalpy flows in rocket engine and hypersonic wind tunnel nozzles. Approximate methods have been developed for predicting the frozen level of molecular dissociation for the nozzle flow of diatomic gases. The purpose of this note is to evaluate approximate solutions for the frozen dissociation fraction in oxygen and hydrogen nozzle flows, previously obtained by the method of Hall and Russo (item no. 424, Vol. III).

724

Cornell Aeronautical Lab., Inc., Buffalo, N. Y

LOCAL ATOM CONCENTRATIONS IN HYPERSONIC DISSOCIATED FLOWS AT LOW DENSITIES, by R. A. Hartunian. [1962] [6]p. incl. diagrs. refs. [AF 49-(638)782] Unclassified

Published in Phys. Fluids, v. 6: 343-348, Mar. 1963.

The theory of a probe to measure local atom concentrations in hypersonic flows of a dissociated gas at low densities is presented. The probe operates on a principle of measuring the differential heat transfer between catalytic and noncatalytic gauges immediately adjacent to one another on the stagnation line of a cylindrical model. The theoretical performance of the probe in the free molecule, the viscous shock layer, and the boundary layer regimes, respectively, is considered. It is shown that the probe cannot be operated successfully in the free molecule regime, except under unusual circumstances. In continuum flow, it is shown that under those conditions necessary for the atoms in the free stream to reach the surface of the probe (chemically frozen shock layer and boundary layer), we are always working in the viscous shock layer regime. Accordingly, it is this flow regime in which the probe measurements can be interpreted readily. The results of detailed calculations which relate to the application of this probe to measure local atom concentrations in nonequilibrium, hypersonic nozzle flows are presented. (Contractor's abstract)

725

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SURFACE-RECOMBINATION EFFICIENCIES IN A STEP-FUNCTION FLOW OF ATOMIC OXYGEN (Abstract), by L. L. Myerson. [1962] [1]p. [AF 49(638)-782] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 447, Aug. 24, 1962.

Heat-transfer measurements have been made, by means of thin-film resistance thermometry, which show simultaneously catalytic and noncatalytic transient surface heating. These transients are the first to be observed with millisecond resolution for a well-defined step function of atomic-oxygen concentration in a subsonic flow. The measurements have been achieved by mounting cylindrical probes perpendicular to a flow of undissociated oxygen. Radiofrequency energy then was suddenly imposed on the upstream flow. The transient heating effects of the step-function increase in atomic oxygen were observed on 2 concomitant oscilloscope traces. The excess of catalytic heating, due to the surface recombination of atomic oxygen, over the noncatalytic heating was clearly evident at all times. All catalytic heat-transfer rates showed a rapid rise to a peak value. After this, different types of behavior were noted, apparently dependent on the conditioning and treatment of the catalytic surface. In some cases, the rate of heat transfer remained constant, while in others it dropped from a peak value and then leveled off. Surface-recombination efficiencies have been calculated for various values of the instantaneous heat-transfer rates.

726

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

INVISCID HYPERSONIC AIRFLOWS WITH COUPLED NONEQUILIBRIUM PROCESSES, by J. G. Hall, A. Q. Eschenroeder, and P. V. Marrone. May 1962, 88p. incl. diagrs. tables, refs. (Rept. no. AF-1413-A-2)

(AFOSR-2072) (Sponsored jointly by Advanced Research Projects Agency; and Air Force Office of Scientific Research under AF 49(638)792) AD 277112
Unclassified

Also published in Jour. Aerospace Sci., v. 29: 1038-1051, Sept. 1962. (Title varies)

Analyses have been made of the effects of coupled chemical rate processes in external and internal inviscid hypersonic airflows at high enthalpy levels. Exact (numerical) solutions have been obtained by the inverse method for inviscid airflow over a blunt nose under flight conditions where chemical nonequilibrium prevails through the nose region. Numerical solutions have also been obtained for nonequilibrium expansions of air from initial equilibrium states appropriate to afterbody flows in flight and to hypersonic nozzle airflows. The results illustrate the general importance of the coupling among the reactions considered. These included dissociation-recombination, bimolecular exchange, and ionization reactions. (Contractor's abstract)

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

BLUNT-NOSE INVISCID AIRFLOWS WITH COUPLED NONEQUILIBRIUM PROCESSES, by J. G. Hall, A. Q. Eschenroeder, and P. V. Marrone. [1962] [14]p. incl. diagrs. tables, refs. (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under [AF 49(638)792]) Unclassified

Published in Jour. Aerospace Sci., v. 29: 1038-1051, Sept. 1962.

For abstract see item no. 726, Vol. VI.

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

EFFECTS OF STREAM NONUNIFORMITIES IN HYPERSONIC FLOW (Abstract), by J. G. Hall. [1962] [1]p. [AF 49(638)792] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 446, Aug. 27, 1962.

Conical or wedge-type hypersonic nozzles produce test flows having divergence and axial gradients which can substantially affect the test-model flow field. Previous considerations of consequent effects on surface pressures have been either empirical or by digital machine solutions of specific cases. An analytic approach was taken and general closed-form results obtained for a variety of situations. The simplest approach, which has a broad range of application, involves use of Newtonian flow concepts. The Newton-Busemann relation for surface pressures is shown to give an accurate correction for ambient-flow nonuniformity on comparison with more-accurate analytic solutions obtained, in the present work, for sharp-nosed hypersonic wedges and cones. Blunt-nosed slender-body flows, which are not amenable to Newtonian theory, are handled with perturbation analysis by adapting a detached shock-layer theory previously developed by Cheng for combined bluntness-viscous interaction effects. Closed-form solutions for effects of nonuniform flow on shock shape and surface pressure are obtained for slender blunt plates and cylinders. The effects of both angular divergence and axial gradients in the ambient flow are shown to be significant.

729

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

NONEQUILIBRIUM EXPANSIONS OF AIR WITH COUPLED CHEMICAL REACTIONS, by A. Q. Eschenroeder, D. W. Boyer, and J. G. Hall. [1962] [10]p. incl. diagrs. table, refs. (AF 49(638)792) Unclassified

Published in Phys. Fluids, v. 5: 615-624, May 1962.

Analysis and solutions of the streamtube gas dynamics involving coupled chemical rate equations are carried out. Results are presented for airflows along the surface of blunt bodies and through hypersonic nozzles. Speeds and altitudes corresponding to re-entry were selected to obtain initial conditions for the external flow calculations. Conditions appropriate to hypersonic tunnel testing were chosen for the nozzle flow calculations. Composition histories are shown for a kinetic mechanism including 6 species and 14 reactions. Gas-dynamic effects of nonequilibrium processes qualitatively resemble those reported earlier. However, the freezing process is complicated by the coupling of the nitric oxide shuffle reactions with the dissociation-recombination reactions. In many cases of hypersonic nozzle flows where the energy in nitrogen dissociation is significant, the fast shuffle reactions prevent nitrogen-atom freezing which would otherwise occur if 3-body recombination were the only process operating. Nitrix oxide concentrations undershoot the equilibrium values if the ratio of nitric oxide to oxygen molecule concentrations exceeds unity in the freezing region. This depletion of nitric oxide leads to nitrogen-atom freezing. (Contractor's abstract)

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

THERMAL AND CHEMICAL NONEQUILIBRIUM IN EXPANDING GAS FLOWS (Abstract), by A. Russo, I. Hurle and others. [1962] [1]p. [AF 49(638)792] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 447, Aug. 27, 1962.

Experimental studies are underway on nonequilibrium expansions of high-temperature gases from initial equilibrium states. Here finite-rate deexcitation occurs in contrast to the excitation of shock-wave flow. A

supersonic nozzle is driven by a high-temperature shock tube to explain steady expansions of millisecond duration sufficient for pressure and spectroscopic measurements. Static-pressure distributions have been measured along 15° wedge and conical nozzles for expansions of undissociated N_2 from 4000°K and 50 atm pressure, and expansions of dissociated H_2 plus 92% Ar from 6000°K and 27 to 130 atm. Corrected for wall boundary layer, static pressures show consistent reduction from equilibrium values attributed to freezing of N_2 vibration and H_2 dissociation, respectively. H recombination rates deduced are in order-of-magnitude agreement with shock-wave dissociation results. N_2 vibration freezing is further evidenced by line-reversal temperatures measured along the wedge nozzle using chromium carbonyl as additive. Assuming line reversal gives vibrational temperature, the latter becomes constant along the nozzle as vibration freezes on flow expansion. Vibrational relaxation rates deduced agree reasonably well with shock-wave excitation results.

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SHOCK TUNNEL STUDIES OF HIGH-ENTHALPY IONIZED AIRFLOWS, by A. Q. Eschenroeder, J. W. Daiber and others. July 1962, 72p. incl. illus. diagrs. tables, refs. (Rept. no. AF-1500-A-1) (AFOSR-3025) (AF 49(638)952) AD 283991 Unclassified

The Cornell Aeronautical Lab. 6-ft shock tunnel is described, the effects of nonequilibrium flow in such a device are assessed, and high-enthalpy experiments involving nozzle ionization are discussed. The shock tunnel utilizes heated high-pressure hydrogen for a driver gas to obtain hypersonic airflows at high temperatures and pressures. Reflected shock operation is used with the tailored-interface technique to maximize the duration of steady flow. A significant portion of re-entry flight conditions can be duplicated for various hypersonic vehicles; however, partial simulation may be used to cover a far wider range of velocity and altitude. A general numerical code has been developed for an IBM 704 computer to solve quasi-one-dimensional flows with coupled rate processes. Such theoretical studies are essential for planning and interpreting experiments in high-temperature tunnel flows. Solutions have been obtained for airflows with atoms, molecules, electrons, and ions reacting simultaneously. Investigations of various ion kinetic mechanisms have shown that processes such as charge transfer, impact ionization and mutual neutralization may play significant roles under certain conditions of hypersonic flow in shock tunnels and about blunt bodies in flight. Preliminary experiments carried out in the shock tunnel have dealt with nonequilibrium ionization. Phase shift of microwaves passed through the airflow in the tunnel nozzle has yielded information on deionization kinetics and on the duration of useful test flow. Critical frequencies far below the microwave band are indicated for the gas over the entire range of conditions. These experiments have shown that flows of high enthalpy can be generated by shock tunnels for the detailed study of the ionized shock layer on a hypersonic vehicle. (Contractor's abstract, modified)

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

HYPERSONIC LOW-DENSITY STUDIES OF BLUNT AND SLENDER BODIES, by R. J. Vidal and C. E. Wittliff. [1962] [69]p. incl. illus. diagrs. refs. (AFOSR-3699) (Sponsored jointly by Aeronautical Research Lab.; and Air Force Office of Scientific Research under AF 49(638)952) Unclassified

Low density experimental data obtained with blunt axisymmetric and 2-dimensional bodies, and with a sharp flat plate are presented and compared with existing theories to define the transitions from the classical thin boundary layer regimes to a flow situation approaching free-molecule flow. The results of the blunt body investigations agree well with continuum theory down to the lowest test density, Knudsen number of about one. The results of the sharp flat plate demonstrate that weak interaction theory is accurate through the transition to the strong interaction regime, establish limits on the transition and on the extent of the strong interaction regime, and indicate that slip effects, as opposed to the vorticity interaction and shock wave heating effects, govern the departures from the strong interaction regime. (Contractor's abstract)

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

HYPERSONIC LOW DENSITY STUDIES OF BLUNT AND SLENDER BODIES, by R. J. Vidal and C. E. Wittliff. [1962] [36]p. incl. illus. diagrs. tables, refs. (AFOSR-J1047) (Sponsored jointly by Aeronautical Research Lab.; and Air Force Office of Scientific Research under AF 49(638)952) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 2: 343-378, 1963. (AFOSR-5310)

For abstract see item no. 732, Vol. VI.

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Cornell U., Ithaca, N. Y.

A NOTE ON RELIGIOUS GROUP DIFFERENCES IN INTERACTION PROFILES: A REPLICATION STUDY, by B. Crowther. [1962] [6]p. incl. table. (AFOSR-2081) (In cooperation with Wisconsin U., Madison, AF AFOSR-62-161) (AF AFOSR-61-30) Unclassified

Also published in Psychol. Repts., v. 10: 459-464, Apr. 1962.

This report presents a replication of Stimson's research (1960), which demonstrated several differences among religious group members (a) in their interaction rates as measured by a revision of Bales' Interaction Process Analysis and (b) in their peer and self rankings. Several differences in the procedures of the 2 studies should be noted. Three major religious groups were defined in

the current study, but only 2 groups (Protestants and Jews) were large enough for meaningful comparisons. Stimson defined 7 different ethnic-religious groups in his study. In addition, information was gathered on several variables not mentioned in Stimson's report. While only one of the differences reported here achieved statistical significance, in general the findings are in accord with Stimson's, who found that Jews tended to have the highest rate of interaction and were seen and saw themselves as high in rankings of assertiveness. Their self perceptions of sociability and emotionality were not in accord with peer assessments; they tended to rank themselves high on sociability and low on emotionality, while others ranked them low and high, respectively. Catholics and Protestants tended to be low on rate of interaction and higher than Jews on social acknowledgment. Catholics were high in acts of self analysis. Protestants on the other hand, had low interaction rates in most of the categories. Stimson described Protestants as being reserved and contributing relatively little to the interaction. (Contractor's abstract)

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

PROPERTIES OF Bi_2Te_3 - Sb_2Te_3 ALLOYS, by M. J. Smith, R. J. Knight, and C. W. Spencer. [1962] [20]p. incl. diagrs. tables, refs. (AFOSR-2479) (AF 49(638)-480) AD 295867 Unclassified

Also published in Jour. Appl. Phys., v. 33: 2186-2190, July 1962.

The phase diagram for the Bi_2Te_3-Sb_2Te_3 pseudobinary system is of the solid-solution type, where the distribution coefficient k is equal to unity at 33 [illegible] 66.7 mol % Sb_2Te_3. The c lattice parameter remains essentially constant across the diagram at 30 [illegible] for both slowly crystallized and quenched alloys. For quenched alloys the a lattice parameter decreases almost linearly, from a value of 4.48A, for pure Bi_2Te_3, to a value of 4.275A, for pure Sb_2Te_3; however, a significant contraction from linear variation is found in slowly crystallized materials. E_G diminishes in an essentially linear fashion from 0.16 ev, for pure Bi_2Te_3, to 0.12 ev at 24.2 mol % Sb_2Te_3 in both slowly crystallized and quenched materials. E_G remains approximately constant from 24.2 to 66.7 mol % Sb_2Te_3 for slowly crystallized materials but continues to drop for quenched materials. (Contractor's abstract)

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

EFFECT OF CRYSTALLINE IMPERFECTIONS UPON THE ELECTRICAL PROPERTIES OF SEMICONDUCTING INTERMETALLIC COMPOUNDS, by C. W. Spencer. Final rept. Oct. 15, 1962, 4p. incl. table. (AFOSR-4007) (AF 49(638)480) AD 289056 Unclassified

Two new experimental techniques were developed which made it possible to measure electrical properties at elevated temperatures or under high hydrostatic pressures. A device which enables the measurement of conductivity of Hall constant at temperatures above 600°C was developed. Pressure vessels were constructed to measure resistivity under hydrostatic pressures up to 30,000 atoms and temperatures above 100°C. The properties of Bi_2Te_3 were studied as a function of pressure and alloy composition. For the alloy study, systems of Bi_2Te_3-Sb_2Te_3 and Bi_2Te_3-Bi_2Se_3 were chosen so that systematic substitution at different layers of the Bi_2Te_3 structure was obtained. The properties observed show strong correlation with the anisotropic layer structure of this system. (Contractor's abstract)

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

HYDROGEN NEAR THE MOON, by R. J. Gould. Apr. 1962, 6p. (Rept. no. CRSR 114) (AFOSR-2567) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)915] and National Aeronautics and Space Administration) AD 276448 Unclassified

Relative to the detection of hydrogen in the temporary atmosphere of the moon, it is important to know whether the re-evaporated gas will be in molecular or atomic form. The most favorable case for molecule formation, namely, that in which the hydrogen atoms diffuse randomly is considered. The other possibility is that the incoming protons produce a crack and diffuse back out along this crack. It is concluded that molecule formation would be a minor process and the majority of outgoing hydrogen would leave the surface at thermal velocity and in atomic form.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

THEORETICAL RESEARCH IN ASTROPHYSICS, by T. Gold. Final rept. June 1, 1960-Mar. 31, 1962. Apr. 30, 1962, 5p. (Rept. no. CRSR 118) (AFOSR-2589) (AF 49(638)915) Unclassified

The work accomplished during the contract period covered by this report is briefly described and publications resulting from the studies, covering various phases of astrophysics, are cited. The topics discussed include: (1) the abundance of molecular hydrogen in the galaxy; (2) the hydrogen atmosphere of the moon; (3) the interaction of a tenuous plasma with an antenna; (4) infrared astronomy; (5) plasma and magnetic fields in the solar system; (6) magnetic effects of geomagnetically trapped particles; (7) general relativity; and (8) dynamics of grains.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

DUST, RADIATION PRESSURE AND STAR FORMATION, by M. Harwit. May 1962, 24p. incl. refs. (Rept. no. CRSR 119) (AFOSR-2590) (AF 49(638)915) AD 276449 Unclassified

Also published in Astrophys. Jour., v. 136: 832-843, Nov. 1962.

Spitzer (Astrophys. Jour., v. 94: 232, 1941) has shown that radiation can produce inverse square law attractive forces between absorbing interstellar grains. Whipple (Astrophys. Jour., v. 104: 1, 1946) and Savedoff (Gas Dynamics of Cosmic Clouds, North Holland Publ. Co., Amsterdam, p. 218, 1955) examined whether these forces could cause dust to flow through ambient gas and form dense clouds from which stars would form. Savedoff concluded that appreciable concentration of dust was not to be expected and that radiative effects would be small partly because grains have a high albedo. The problem is here reexamined by considering (1) that instability analogous to gravitational instability can be produced by radiation and (2) that in the neighborhood of hot stars, grains are subjected to high intensity, near ultraviolet irradiation for which the albedo probably is low. On this assumption the minimum mass of a cloud that becomes unstable at the center of an O association can be estimated. It is suggested that O clusters are formed in this manner. The process is of comparable efficiency to Oort's (ibid, p. 147) suggested compression by HII regions and, moreover, does not entail partial destruction of the cloud through ultraviolet ionization. Spitzer's radiative attraction does not appear to play a role with the free radical grains described by Platt (Astrophys. Jour., v. 123: 486, 1956), since these grains effectively scatter but do not absorb radiation. They may, however, be subject to scattering pressures. A laboratory experiment to detect the radiative instability is proposed. It is shown that, near hot stars, radiation pressures can accelerate clouds to speeds comparable to the velocity of interstellar clouds and members of stellar association. Radiation pressures could also account for outflows of gas from galactic nuclei. (Contractor's abstract)

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

PLASMA SHEATHS AND THEIR EFFECTS ON ANTENNAS, by S. J. Peale. May 1962, 63p. incl. diagrs. refs. (Rept. no. CRSR 116) (AFOSR-2960) (AF 49(638)915) AD 278683 Unclassified

It is shown that the lack of conservation of particles does not allow the establishment of Maxwell density distribution for either electrons or ions in a plasma sheath. However, it is seen that even in this steady state case the electrons assume a distribution that is almost Maxwellian. Thus, in situations where a finite body is moving at a velocity comparable to ion thermal velocities, the ion density will be approximately constant and equal to that in the undisturbed plasma, while the electrons can be approximated by a Maxwell density distribution with only a small error. (Contractor's abstract)

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

MAGNETIC EFFECTS OF GEOMAGNETICALLY TRAPPED PARTICLES, by M. L. Dwarkin. May 1962, 41p. incl. diagrs. tables, refs. (Rept. no. CRSR 117) (AFOSR-3003) (AF 49(638)915 AD 278650 Unclassified

Analysis and calculations of the fields at the surface of the earth due to narrow belts of trapped particles provide a basis for discussing some magnetic effects of geomagnetically trapped particles. The assumption that the particles are trapped in a centered dipole field guarantees the symmetry of magnetic sources about the geomagnetic equatorial plane as well as about the geomagnetic axis, and therefore the same symmetries obtain for the magnetic field at the surface of the earth due to the motion of the particles. Hence, only the field along an arbitrary meridian in one hemisphere is considered. The symmetries of the magnetic source are exactly those of sets of coaxial Helmholtz coils. (Contractor's abstract)

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y

ARECIBO IONOSPHERIC OBSERVATORY, by W. E. Gordon, L. M. LaLonde, and T. E. Talpey. Summary technical rept. no. 1, June 30, 1962, 15p. incl. diagr. (Research rept. no. RS 41) (AFOSR-3377) (AF 49-(638)1156) AD 291652 Unclassified

The objectives of the project are as follows: (1) to measure certain parameters of the ionosphere (total received intensity, frequency spectrum of the main signal component, detect and measure the plasma lines, detect and measure the "hybrid resonance" lines, and at lower heights measure the distribution of total intensities of the signal from a single pulse); (2) study and measure certain parameters of lunar, planetary, and solar echoes; (3) survey radio sources, radio emissions and flare star radiation at 430 mc/sec; (4) make measurements at 20 and 1420 mc/sec; (5) conduct tests on and use a large vertical horn antenna; and (6) install a high-powered transmitter for ionospheric scatter observations.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

ARECIBO IONOSPHERIC OBSERVATORY, by W. E. Gordon, L. M. LaLonde and others. Summary technical rept. no. 2, Dec. 31, 1962, 30p. incl. illus. diagrs. (Research rept. no. RS 44) (AF 49(638)1156) AD 297354 Unclassified

A summary of the research conducted to date is presented. Research at the Arecibo site has centered on tests with the horn antenna, radar observations of the moon, and the development of a 40 mc/sec radar. Experiments concerning a model ionosphere for density and Faraday rotation measurements are being conducted in Ithaca, as are a wide variety of plasma physics studies. The reflection of radio waves from the sun and lunar echoes are also being studied.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

DENSITY FLUCTUATIONS IN A NONEQUILIBRIUM PLASMA, by E. E. Salpeter. [1962] [13]p. incl. refs. (AF 49(638)1156) Unclassified

Published in Jour. Geophys. Research, v. 68: 1321-1333, Mar. 1, 1963.

A dilute ionized gas is considered, for which electron-ion collisions can be neglected and which deviates from thermal equilibrium by having an ion temperature T_i different from the electron temperature T_e. These conditions apply to the ionosphere in the F layer and above. Methods are reviewed for treating statistical mechanics at thermal equilibrium and the Boltzmann equation for general problems. The electron-electron, electron-ion, and ion-ion pair correlation functions are derived for general T_e/T_i and an arbitrary time-independent magnetic field. The total cross section for scattering of an electromagnetic wave from such a gas is derived for general T_e/T_i. The results are shown to agree with the integral of the theoretical frequency spectrum derived previously by a number of authors. For long wavelength and $T_i/T_e \ll 1$ the cross section is proportional to T_i/T_e. The sources of error for an incorrect result stated by Renau are explained. (Contractor's abstract)

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

COSMIC RAYS AND THE INTERPLANETARY MEDIUM, by T. Gold. [1962] [3]p. incl. diagrs. (AFOSR-3824) (AF AFOSR-62-191) Unclassified

Also published in Astronautics, v. 7: 43-45, Aug. 1962.

A discussion of the gas masses in interplanetary space, of cosmic rays, and of hazards to manned space flights from solar flares is presented.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

EXPECTED NEAR INFRARED RADIATION FROM INTERSTELLAR MOLECULAR HYDROGEN, by R. J. Gould and M. Harwit. Aug. 31, 1962 [4]p. incl. table, refs. (AFOSR-J370) (AF AFOSR-62-191) AD 408582 Unclassified

Also published in Astrophys. Jour., v. 137: 694-697, Feb. 15, 1963.

Stellar radiation excites hydrogen molecules into excited electronic states. These molecules then revert to the ground electronic state and can be left in an excited vibrational state. Radiation emitted in the transition from these excited states down to the ground vibrational state produces lines at 2.12μ and 2.22μ which are observable through the earth's atmosphere. A calculation of the expected flux received at the earth's surface in these lines suggests that conventional infrared detectors should be capable of detecting such radiation from bright emission nebulae, thus enabling the H_2 density in these regions to be determined.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

ORIGINS OF THE ZODIACAL DUST CLOUD, by M. Harwit. [1962] [10]p. incl. diagr. refs. (AFOSR-J716) (AF AFOSR-62-191) AD 414129 Unclassified

Also published in Jour. Geophys. Research, v. 68: 2171-2180, Apr. 15, 1963.

The total intensity of light scattered by interplanetary dust has usually been directly related to the dust mass lost because of the Poynting-Robertson effect. The scattered light intensity thus would appear to define a dust supply rate that must be maintained if the dust intensity is to remain constant. This work suggests that comets apparently cannot supply this quantity of dust to the cloud, because radiative pressures prevent most of the comet debris and its secondary collision fragments from entering closed orbits about the sun. More observations on the actual emission rates of very-short-period comets may be needed before this can be conclusively established. It is shown that asteroidal collisions can provide sufficient debris, but the injection rate is extremely variable because most of the debris must be produced in very rare collisions between the largest asteroids. It is concluded that no current theory is capable of accounting for a steady cloud. A possible solution might be found in processes that would counter in Poynting-Robertson drag and permit grains to be long lived. The present comet dust supply rate might then be adequate to account for a stationary cloud. An alternative is a highly variable cloud, with dust produced in asteroidal collisions. The present epoch would then have to be one of unusually high dust density. (Contractor's abstract)

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Cornell U. Dept. of Biochemistry, Ithaca N. Y.

FERMENTATION, by M. Gibbs. [1962] [7]p. incl. table, refs. (AFOSR-345) (AF 49(638)798) Unclassified

Also published in Physiology and Biochemistry of Algae, ed. by R. A. Lewin. New York, Academic Press, 1962, p. 91-97.

For abstract see item no. 750, Vol. VI.

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Cornell U. [Dept. of Biochemistry] Ithaca, N. Y.

THE BIOSYNTHESIS OF CAFFEINE IN THE COFFEE PLANT, by L. Anderson and M. Gibbs. [1962] [4]p. incl. table, refs. (AFOSR-2208) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)798, Atomic Energy Commission, and National Science Foundation) Unclassified

Also published in Jour. Biol. Chem., v. 237: 1941-1944, June 1962.

It was concluded that the xanthine base of caffeine is synthesized from the same precursors as are purines in all of the other systems which have been studied. The xanthine is converted to 7 (or 3)-methylxanthine and, in turn, to theobromine and caffeine. The 8-carbon atom of glycine, formaldehyde, formate, methanol, and the methyl carbon atom of methionine are active precursors of the N-1, N-3, or both methyl carbon atoms of caffeine. The primary effect of light is an enhancement of purine ring formation. The methyl carbon atom of methionine is not a precursor of the ureido carbons of caffeine.

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Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

FERMENTATION, by M. Gibbs. [1962] [7]p. incl. table, refs. (AFOSR-J198) (AF 49(638)798) AD 400181 Unclassified

Also published in Physiology and Biochemistry of Algae, ed. by R. A. Lewin. New York, Academic Press, 1962, p. 91-97.

A synopsis of recent literature in algae fermentation is given. The main concern is with rate of fermentation, end-products of fermentation, fermentation inhibitors, pathway of fermentation and anaerobic growth.

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Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

RESPIRATION, by M. Gibbs. [1962] [30]p. incl. table, refs. (AFOSR-J199) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)798 and National Science Foundation) AD 400180 Unclassified

Also published in Physiology and Biochemistry of Algae, ed. by R. A. Lewin. New York, Academic Press, 1962, p. 61-90.

An assembly and assessment of the voluminous and widespread publications concerned with the basic metabolism process of general algae physiology as related to the major topics of respiration is presented. The major sections of respiration discussed are: (1) rate of respiration, (2) respiratory quotient, (3) respiratory pathways, and (4) special aspects of algae respiration.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

[INELASTIC MOLECULAR COLLISONS] by B. Widom. Interim final rept. July 2, 1962, 2p. (AFOSR-2939) (AF 18(603)111) AD 286410 Unclassified

The project was initiated to develop theories of inelastic molecular collisions in gases. Two different kinds of questions arose: (1) what are the cross-sections and transition probabilities for the individual vibrational and rotational excitations which occur and (2) how are the relaxation times and reaction rates related to the transition probabilities?

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

MAGNETIC RESONANCE STUDIES OF LITHIUM VANADIUM BRONZE, by J. Gendell, R. M. Cotts, and M. J. Sienko. Jan. 16, 1962. 27p. incl. diagrs. tables, refs. (AFOSR-1959) (AF 49(638)191) AD 275086 Unclassified

Also published in Jour. Chem. Phys., v. 37: 220-225, July 15, 1962.

The nuclear magnetic resonance of Li^7 in $Li_xV_2O_5$ shows no Knight shift, but there is a small diamagnetic shift relative to LiCl solution, amounting to 0.0023 and 0.0058% at 296° and 77°K, respectively. The spin-lattice relaxation time T_1 as measured by pulse experiments, decreases from 0.16 sec at 296°K to a minimum of 0.060 sec at 163°K and then rises to 0.13 sec at 77°K. The free-induction decay half-width decreases from 850 μ sec at 296°K to 100 μ sec at 77°K. The minimum in T_1 is attributed to back-and-forth motion of the lithium ions within but normal to the axis of channels in the oxygen framework; the line narrowing, to diffusion along the channel from 1 unit cell to an adjacent one. EPR studies give Lorentzian-shaped lines, centered at g = 1.96, of intensity proportional to 1/T. Results are consistent with a model in which lithium atoms in a host V_2O_5 structure are completely ionized to give Li^+ ions and electrons which are almost, but not completely, localized as V^{4+} centers. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

RESEARCH ON NEW SOLID STATE DEFECT STRUCTURES BASED ON WO_3 AND ON V_2O_5, by M. J. Sienko. Final rept. Sept. 30, 1962, 12p. (AFOSR-3911) (AF 49-(638)191) AD 407150; AD 414435 Unclassified

The project was initiated to follow up the discovery that in the tungsten bronze series (M_xWO_3, $0 < x \leq 1$, M = univalent metal) the copper tungsten bronzes (M = Cu) behaved as semiconductors whereas the alkali tungsten bronzes were metallic. An excitation energy which might be a function of the ionization potential of M is suggested along with the possibility that with appropriate choice of M in WO_3 one might develop a series of materials, based on the same host matrix which would represent a continuous gradation in properties from insulating to metallic. The problem dissolved into one of an attempt to define the current carriers in Cu_xWO_3, their concentration, and their mobility as a function of temperature.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

ELECTRICAL AND MAGNETIC PROPERTIES OF POTASSIUM TUNGSTEN BRONZE AND RUBIDIUM TUNGSTEN BRONZE, by M. J. Sienko and S. M. Morehouse. Sept. 1962 [20]p. incl. diagrs. tables, refs. (AFOSR-5003) (AF 49(638)191) AD 408532 Unclassified

Also published in Inorg. Chem., v. 2: 485-489, June 1963.

Single crystal conductivities have been measured for $K_{0.40}WO_3$ and $Rb_{0.32}WO_3$ in the range 150° to 370°K. Carrier mobilities, which are somewhat higher than in the Li and Na tungsten bronzes, closely follow a $T \sinh^2(\theta/2T)$ dependence. Calculations on the basis of the theory of Howarth and Sondheimer strongly support the assumption that the thermal part of the carrier mobility in the tungsten bronzes is primarily determined by polar scattering from optical mode lattice vibrations. Magnetic susceptibilities also have been measured at room temperature for $Rb_{0.26}WO_3$ and $K_{0.23\text{-}0.45}WO_3$. Results are as predicted by the Pauli-Peierls theory for quasi-free electrons. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

SOME SOLID-STATE STUDIES OF TUNGSTEN TRIOXIDE AND THEIR SIGNIFICANCE TO TUNGSTEN BRONZE THEORY, by B. L. Crowder and M. J. Sienko. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-J1103) (AF 49(638)191) AD 420623 Unclassified

Also published in Jour. Chem. Phys., v. 38: 1576-1583, Apr. 1, 1963.

The Hall voltage, resistivity, and thermoelectric power have been measured on single crystals of tungstic oxide (γ phase, 10° to 330°C). The electrical transport properties can be explained quantitatively on the basis of a shallow donor model ($E_D = 0.04$ ev) in which carrier mobility is limited primarily by polar scattering from optical mode lattice vibrations. The interaction between electron and phonon is described by the perturbation theory of Howarth and Sondheimer (replacing the effective mass by the polaron mass) or by the intermediate coupling theory of Lee, Low, and Pines. The model has been extended successfully to calculate the thermal and composition dependences of resistivity and Seebeck coefficient for the cubic sodium tungsten bronzes.

757

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

ELECTRON SPIN RESONANCE STUDY OF PARTIALLY REDUCED VANADIUM PENTOXIDE, by J. L. Ragle. [1962] [5]p. incl. diagrs. table, refs. (AFOSR-J1556) (AF 49(638)191) AD 427402 Unclassified

Also published in Jour. Chem. Phys., v. 38: 2020-2024, Apr. 15, 1963.

For abstract see item no. 758, Vol. VI.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

ELECTRON-SPIN RESONANCE STUDY OF PARTIALLY REDUCED VANADIUM PENTOXIDE, by J. L. Ragle. Sept. 7, 1962, 21p. incl. diagrs. refs. (AF 49(638)191) AD 406288 Unclassified

Published in Jour. Chem. Phys., v. 38: 2020-2024, Apr. 15, 1963. (AFOSR-J1556; AD 427402)

Single crystals of partially reduced vanadium pentoxide have been prepared in the form $Cu_xV_2O_5$ with $0 \leq x \leq 0.040$, and 2 distinct types of paramagnetic species have been observed by ESR techniques. Neither of these species is associated with copper (II). For $0 \leq x \leq 0.0058$, the dominant species is 1 in which the electron is localized, the hyperfine structure indicating interaction with 2 equivalent vanadium nuclei. This center is apparently identical to that observable in ordinary laboratory reagent grades of vanadium pentoxide. In addition, for $0.0078 \leq x$, the spectra show a superimposed single narrow line of total width 10-20 G. The g tensor of this species show that it is still primarily associated with the vanadium sites, but the lack of hyperfine structure indicates a considerable mobility. The latter species is not observed in pure vanadium pentoxide but is very similar to the mobile species observed in vanadium bronzes. (Contractor's abstract)

759

Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

SPECIES IN CONCENTRATED AQUEOUS SOLUTIONS, by R. A. Plane. Final rept. Aug. 23, 1962, 5p. (AFOSR-3472) (AF 49(638)279) AD 284898) Unclassified

A discussion is presented of data obtained from Raman spectroscopy, and a range of topics important for the characterization of the molecular species present in concentrated aqueous solutions including complex ions, hydrated ions, and low molecular weight inorganic polymers

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

A RAMAN STUDY OF GALLIUM BROMIDE SOLUTIONS, by J. Nixon and R. A. Plane. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-64-1402) (AF 49(638)279) AD 444453 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 4445-4448, Dec. 5, 1962.

Raman spectral intensity measurements were made for gallium bromide solutions which contained various ratios of these 2 ions. The only spectrum evident was that of the tetrahedral $GaBr_4^-$ ions. The frequencies, depolarization ratios and intensities relative to ν_1 of this species were found. From Raman intensities, the concentration of $GaBr_4^-$ in a variety of solutions at temperatures up to 95° was found and used to evaluate the thermodynamics parameters for its formation in composition. The enthalpy and entropy values were found to be independent of temperature but varied somewhat with solution composition. At an ionic strength of 10M, the enthalpy of formation was found to be +9.5 kcal/mol and the entropy 12.5 cal/mol-degree. Because of partial cancellation of the ionic strength, changes of entropy and enthalpy the association equilibrium quotient was reasonably constant. At 25°, the average value for the log of the association quotient was determined to be -4.3. Finally, the entropy of hydration of $GaBr_4^-$ was evaluated as -63 cal/mol-degree. (Contractor's abstract, modified)

761

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

RAMAN SPECTRA OF AQUEOUS SOLUTIONS OF INDIUM SULFATE, NITRATE, AND PERCHLORATE, by R. E. Hester, R. A. Plane, and G. E. Walrafen. Aug. 1962, 2p. incl. tables, refs. (AFOSR-64-1403) (AF 49(638)279) AD 444954 Unclassified

Also published in Jour. Chem. Phys., v. 38: 249-250, Jan. 1, 1963.

For a series of metal-ion sulfate solutions investigated, only In^{3+} showed Raman spectral evidence of association with $SO_4^=$. The evidence consisted of the appearance in indium sulfate solutions of 4 new polarized lines in the Raman spectrum. Raman intensity data, particularly in mixed indium sulfate-indium perchlorate solutions, verified the new species as an indium-sulfate complex; however, these data did not permit a decision between the presence of $InSO_4^+$, $In(SO_4)_2^-$, or a mixture of the two. The fact that the 255 cm^{-1} line was found to be highly polarized suggested that a linear $In(SO_4)_2^-$ species might be of major importance. Finally, all indium solutions, even those with ClO_4^- as the only anion, showed a broad polarized band near 400 cm^{-1} which probably resulted from hydrated In^{3+}.

762

Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

ANALYTICAL APPLICATIONS OF FLAME SPECTROSCOPY, by W. D. Cooke. Final rept. [1962] 3p. (AFOSR-4307) (AF 49(638)484) Unclassified

For the first time atomic emission intensities of spectral lines have been predicted from flame sources. A quantitative explanation of the role of organic solvents in the enhancement of atomic emission is offered. Research was also undertaken to investigate chemi-excitation processes in flames. It was shown that tin atoms are not in thermal equilibrium in a flame and that this fact is the cause of the abnormally high line intensities.

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Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

EXCITATION PROCESSES IN FLAME SPECTROMETRY, by J. H. Gibson, W. E. L. Grossman, and W. D. Cooke. [1962] [12]p. incl. diagrs. refs. (AFOSR-J584) (AF 49-(638)484) AD 415210 Unclassified

Also published in Anal. Chem., v. 35: 266-267, Mar. 1963.

Experimental procedures have been devised through which it is possible to understand quantitatively some of the fundamental processes of flame spectrometry. The effect of various parameters involved in the enhancement of emission by organic solvents can be evaluated quantitatively. In the case of sodium and calcium, the enhancement is caused partially by more rapid evaporation of solvent and partially by an increase in flame temperature. In the case of tin, a further contribution of chemiluminescence is noted. By flame temperature measurements, population distributions and ground state concentrations, it is possible to predict flame emissivity to a few per cent. The rate of solvent evaporation, oxide formation, and flame dilution effects are discussed in relation to their effect on emission. Some possible mechanisms for the excitation of tin by collisions with free radicals are discussed. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

EVIDENCE FOR THE FORMATION OF BIPHENYL BY INTRAMOLECULAR DIMERIZATION IN THE ELECTROOXIDATION OF TETRAPHENYLBORATE ION, by D. H. Geske. [1962] [1]p. incl. diagr. (AFOSR-2526) (AF AFOSR-61-18) Unclassified

Also published in Jour. Phys. Chem., v. 66: 1743-1744, Sept. 1962.

The electrooxidation of tetraphenylborate ion at a platinum electrode in acetonitrile has previously been reported (Jour. Phys. Chem., v. 63: 1062-1070, July 1959). Further work has now been done which suggests that the 2 phenyl radicals in the transition state of oxidized tetraphenylborate undergo intramolecular dimerization. Acetonitrile solution mixtures of tetramethylammonium perdeuteriotetraphenylborate,

$(CH_3)_4N^+B(C_6D_5)_4^-$, and ordinary tetramethylammonium tetraphenylborate were electrolyzed. Mass spectral examination of the biphenyl compounds produced showed that only $(C_6H_5)_2$ and $(C_6D_5)_2$ were formed, a result consistent with the intramolecular dimerization mechanism. It seems entirely reasonable to reject the suggestion that there are certain electrode sites on which the perdeuteriotetraphenylborate ion oxidation occurs and other sites on which ordinary tetraphenylborate ion oxidizes. The evidence points unequivocally to the intramolecular dimerization mechanism as the correct one.

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Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

CRITICAL OPALESCENCE OF BINARY LIQUID MIXTURES: METHANOL-CYCLOHEXANE; ANILINE-CYCLOHEXANE, by P. Debye, B. Chu, and H. Kaufmann. [1962] [4]p. incl. tables, refs. (APOSR-3791) (AF AFOSR-62-12) Unclassified

Also published in Jour. Chem. Phys., v. 36: 3378-3381, June 15, 1962.

For some liquid mixtures, anomalies in the coexistence curve have been observed. Experiments are reported on the angular dissymmetry of visible light as well as on the temperature dependence of the zero-angle scattering for 2 liquid mixtures. The mixture methanol-cyclohexane behaves normally, the other, aniline-cyclohexane, shows anomalies. (Contractor's abstract)

766

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

MOLECULAR CONFIGURATION OF POLYSTYRENE IN BENZENE, by P. Debye, B. Chu, and H. Kaufmann. July 24, 1962, 8p. incl. diagrs. tables. (AFOSR-3860) (AF AFOSR-62-12) AD 416383 Unclassified

Also published in Jour. Polymer Sci., Part A, v. 1: 2387-2394, July 1963.

The particle scattering factor P(θ) with Gaussian statistics for polydispersed systems has been treated. For a polystyrene sample with a sharp molecular weight distribution ($M_w/M_n < 1.02$, $M_w = 1.5 \times 10^6$), the measured angular dependence of scattered intensity indicates that the polymer coil does obey Gaussian statistics. This holds for a range of concentrations provided the variation of the constant representing the radius of gyration with concentration is adjusted.

767

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

CRITICAL OPALESCENCE OF POLYSTYRENE IN ETHYLCYCLOHEXANE, by P. Debye, D. Woermann, and B. Chu. [1961] [5]p. incl. diagr. table. (AF AFOSR-62-12) Unclassified

Published in Jour. Polymer Sci., Part A, v. 1: 255-259, Jan. 1963.

The range of molecular forces and the critical temperature of polystyrene in ethyl-cyclohexane are calculated from measurements of the angular dependence of critical opalescence. The polystyrene samples have molecular weights ranging from 69,000 to 552,000. The range of molecular forces remains strikingly small and is comparable with values obtained earlier on the system polystyrene-cyclohexane.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

VISCOSITY OF CRITICAL MIXTURES, by P. Debye, B. Chu, and D. Woermann. [1961] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-12], Office of Naval Research, and National Science Foundation) Unclassified

Published in Jour. Polymer Sci., Part A, v. 1: 249-254, Jan. 1963.

Measurements of the viscosity of critical mixtures were extended to high polymer solutions (polystyrene-cyclohexane). An anomaly is found in the temperature coefficient of the viscosity. An empirical expression for the viscosities of critical mixtures as a function of $\Delta T/T_c$, where $\Delta T = T - T_c$, and T_c is the critical temperature, is derived.

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Cornell U. Dept. of Engineering Physics, Ithaca, N. Y.

THE OXIDATION OF COPPER SINGLE CRYSTALS, by E. Yoda and B. M. Siegel. [1962] [2]p. (AFOSR-3389) (Sponsored jointly by Advanced Research Projects Agency; and Air Force Office of Scientific Research under AF AFOSR-62-7) AD 427649 Unclassified

Also published in Electron Microscopy, Fifth Internat'l. Cong., Philadelphia, Pa. (Aug. 29-Sept. 5, 1962), New York, Academic Press, v. 1: C-6, 1962. (AFOSR-3384)

The oxidation of Cu single crystals at low partial pressures of oxygen has been investigated by direct observation of the changing reflection electron diffraction patterns during the reaction. Changes in the integrated intensities of Kikuchi lines and diffracted spots from the different phases have been followed and related to the kinetics of the reaction. The model for the mechanism of nucleation and growth of the oxide phase has been taken from observations made by electron microscopy through replication of the oxidized single crystals. The electron micrographs of the replicated surfaces showed widely spaced, isolated crystallites, leaving large areas between the crystallites apparently unchanged or only slightly rougher than the original surface. The crystallites are interpreted to be the Cu_2O phase. Electron diffraction patterns taken at various stages of oxidation

gave spot patterns for the Cu_2O with a preferred orientation of the crystallites in which the [100] of the oxide was parallel to the [100] of the Cu single crystal. The electron diffraction pattern from the Cu crystals before exposure to high temperature oxidation showed only well defined Kikuchi patterns with a few spots from Cu. After exposure to oxygen, the Kikuchi pattern and spots from the Cu were weak and some strong spots corresponding to the reflections from the Cu_2O phase were observed. When the same oxidized specimen was heated in a vacuum, diffraction patterns showed increasing intensity in the Cu Kikuchi pattern as well as some increase in the integrated intensity in the Cu_2O spots.

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Cornell U. Dept. of Engineering Physics, Ithaca, N. Y.

INTENSITY INCREASE OF KIKUCHI LINES DURING ELECTRON BOMBARDMENT, by E. Yoda. [1961] [2]p. incl. diagr. (AFOSR-64-0380) [AF AFOSR-62-7] AD 433073 Unclassified

Also published in Jour. Appl. Phys., v. 33: 764-765, Feb. 1962.

The change of intensity profiles of Kikuchi lines obtained in reflection electron diffraction from freshly cleaved surfaces of NaCl were followed as a function of time of exposure of the crystal to the electron beam. The reduced data taken from microphotometer traces of photographic exposures gave values accurate to about ± 3%. At first, there is a slight, but definite, increase with time. The increment is about 5% after 3 min of electron bombardment with a beam density of 3μ amp/cm^2. The intensity decreased rapidly after 3 min at this exposure density.

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Cornell U. Dept. of Engineering Physics, Ithaca, N. Y.

REDUCTION OF CONTAMINATION IN REFLECTION ELECTRON DIFFRACTION, by E. Yoda and B. M. Siegel. [1961] [4]p. incl. diagrs. (AFOSR-64-0381) [AF AFOSR-62-7] AD 433071 Unclassified

Also published in Jour. Appl. Phys., v. 33: 1419-1422, Apr. 1962.

The rate at which contamination forms on surfaces exposed to electron beams in reflection electron diffraction has been investigated for electropolished single crystals of copper and cleavage faces of alkali halide crystals by observing the decrease of the intensity in the diffraction pattern. It was found that a cold chamber at liquid nitrogen temperatures surrounding the specimen reduces the contamination rate on copper by an amount directly proportional to the solid angle through which the specimen is exposed to the vacuum system, and at the smallest aperture, lowers the rate by as much as 2 orders of magnitude. Color centers were produced in the alkali halide crystals exposed to the electron beam. The resultant imperfections in the crystal lattice apparently affected the diffraction spot intensity, making measurement of contamin[illegible] rates by this method unsatisfactory.

772

Cornell U. [Dept. of Mathematics] Ithaca, N. Y.

PRODUCTS OF INDECOMPOSABLE, APERIODIC, STOCHASTIC MATRICES, by J. Wolfowitz. [1962] [5]p. [AF 49(638)226] Unclassified

Presented at meeting of the Amer. Math. Soc. June 6, 1962.

Published in Proc. Amer. Math. Soc., v. 14: 733-737, Oct. 1963.

An n x n matrix $P = \{p_{ij}\}$ is called stochastic indecomposable aperiodic (SIA) if all $p_{ij} \geq 0$, all $\Sigma_j p_{ij} = 1$ and $Q = \lim_{n \to \infty} P^n$ exists and has all rows equal. The author proves that if $A_1, \ldots, A_k$ are n x n matrices any finite product of which (in any order) is SIA, then for $\epsilon > 0$ there is an integer $\nu(\epsilon)$ such that $n \geq \nu(\epsilon)$ implies that every product of n A_i's has rows which differ by at most ϵ. Under certain conditions, infinitely many A_i may be considered. The result is related on one of Sarymsakov but includes cases not treated in the latter. The author also discusses simplifying a method of Thomasian for verifying the hypothesis of the theorem. (Math. Rev. abstract)

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Cornell U. Dept. of Physics, Ithaca, N. Y.

THEORY OF THE X-RAY ABSORPTION SPECTRUM OF ARGON, by T. Watanabe. Apr. 10, 1962 [10]p. incl. diagrs. tables. (Research rept. no. 12) (AFOSR-2254) (AF 49(638)402) AD 281731 Unclassified

The oscillator strengths of the 1s - 4p and 1s - 5p x-ray transitions in atomic argon were calculated using Hartree-Fock wavefunctions. It was assumed that (1) the effect of the 1s-hole is to reduce electronic screening by unity so that the final orbital of the ejected electron is essentially that in a simply excited potassium atom, (2) the remaining electrons retain essentially their respective radial positions before and after production of the 1s-hole, and (3) the coupling between the 1s-hole and the 4p or 5p electron is small. The oscillator strengths, based on the dipole moment expressions, were found to be 0.0016 for the 1s - 4p and 0.00053 for the 1s - 5p transitions, respectively. Experimental values, viz, 0.0018 and 0.00057, are in good agreement. Although the reality of assumptions made is not clear in view of the very short life time of the K state of argon, the agreement between the calculated and the experimental values suggests some interesting speculations. (Contractor's abstract)

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Cornell U. Dept. of Physics, Ithaca, N. Y.

SPURIOUS SPECTRAL EFFECTS AND ALIGNMENT PROCEDURES IN X-RAY SPECTROMETRY, by H. W. Schnopper. Apr. 15, 1962, 82p. incl. diagrs. refs. (Research rept. no. 13) (AFOSR-2418) (AF 49(638)402) AD 278811 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 504, Aug. 27, 1962.

The spurious spectral effects of (1) vertical divergence and (2) improper spectrometer alignment (crystals and x-ray beam) are discussed. The distortions produced in such spectral features, as Bragg angle, line shape, width and asymmetry are illustrated both theoretically and experimentally. A new method is described for aligning the crystals, which makes use of the non-dispersive (1, -1) position, and which is independent of vertical divergence. Significant new conclusions of this study are (1) the crystal alignment and the beam alignment must be treated separately and with equal care, and (2) perfect crystal alignment cannot be conveniently achieved in the presence of vertical divergence. Quantitative discussion is given of the spectral distortions which arise from vertical divergence even for perfect alignment of the crystals and of the x-ray beam. (Contractor's abstract)

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Cornell U. [Dept. of Physics] Ithaca, N. Y.

Kβ EMISSION SPECTRUM OF ARGON GAS (Abstract), by R. D. Deslattes. [1962] [1]p. [AF 49(638)402] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 86, Jan. 24, 1962.

Primary radiation from an x-ray tube with a tin target operated at 3 kw was admitted to a cell containing argon gas by means of a tin beryllium window. Fluorescent radiation which left the cell through a second beryllium window was analyzed by a 2-crystal spectrometer accepting 8 parallel beams of limited vertical divergence. Intensities were measured by means of a large flowing-gas proportional counter. Data acquisition was carried out by means of automatic devices and the information stored in punched tape for subsequent computer reduction. Detailed measurements are here reported of the Kβ region of the argon spectrum. In addition to the already known $\beta_{1,3}$ and β' lines, a line which corresponds to β'' in neighboring elements, has been observed. It is also clear from this data, but not from previous measurements, that β' is complex. The energy positions of the satellite lines of $\beta_{1,3}$ are consistent with those which would arise from single photon production of double initial vacancies. It is finally of some interest to note that this argon spectrum resembles closely the spectra of Cl^- and K^+ as observed in KCl.

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Cornell U. [Dept. of Physics] Ithaca, N. Y.

K-SERIES VALENCE-EMISSION BAND OF CHLORINE IN KCl—EFFECT OF EXCITATION ENERGY (Abstract), by R. D. Deslattes. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency; Air Force Office of Scientific Research under [AF 49(638)402], and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 221, Mar. 26, 1962.

The spectral region near the K-series valence-emission band of chlorine in solid KCl has been studied in fluorescence with a variety of primary x-ray beams. Specifically, the fluorescent spectrum was excited by primary radiation from the L series of Pd, Ag, and Sn and the K series of Ti. In this way, excess energies above the threshold for Cl K-series emission, ranging from approximately 1.5 to 100 rydbergs, were employed. The spectra were analyzed by means of a 2-crystal vacuum spectrometer. Intensities were measured by a flowing-gas proportional counter driving conventional electronic circuitry. Two principal effects are reported. First, the intensity of the prominent, high-energy satellite β_x relative to that of the main band decreased with decreasing excess energy in a fashion consistent with a KM_1 initial state for this satellite transition. Second, the main band $K\beta_{1,3}$ varied in shape; its width and asymmetry increased with increasing excess energy. This suggests the presence of almost-degenerate satellite transitions.

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Cornell U. Dept. of Physics, Ithaca, N. Y.

LIFETIME OF d-BAND HOLES IN InSb, by R. D. Deslattes. [1962] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)402] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 129: 1511-1512, Feb. 15, 1963.

Profiles of the $InL\beta_2$ x-ray emission in metallic indium and in InSb have been recorded by means of a vacuum 2-crystal instrument. According to the usual term assignments, the final state for this transition contains a hole in the 4d band. With suitable assumptions regarding both this state and the initial state, an approximate measure of the decay width of the 4d hole is obtained.

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Cornell U. [Dept. of Physics] Ithaca, N. Y.

MULTIPLE EXCITATION AND IONIZATION OF INNER ATOMIC SHELLS BY X-RAYS (Abstract), by H. W. Schnopper and L. G. Parratt. [1962] [1]p. [AF 49(638)-402] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 338, Apr. 23, 1962.

Reinvestigation of the argon-K absorption-edge region has revealed a new resonance-absorption structure followed by a new continuum. These new features may be interpreted as arising from double-electron-excitation processes in which an M electron as well as a K electron takes part in the transitions. The first new resonance line lies about 23 ev above the first line in the previously observed single-electron excitation-resonance structure. No additional resonance structure was found in the region zero to about 50 ev. The results of this experiment are particularly interesting, since the physical system dealt with is such a simple, theoretical case, viz, a monatomic noninteracting atom; however, no significant theoretical predictions of multiple excitation or ionization of inner shells have yet been made.

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Cornell U. [Dept. of Physics] Ithaca, N. Y.

PENNING DISCHARGE AS A SOURCE IN THE EXTREME ULTRAVIOLET, by R. D. Deslattes, T. J. Petersen, Jr., and D. H. Tomboulian. [1962] [3]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)402] and Office of Naval Research) Unclassified

Published in Jour. Opt. Soc. Amer., v. 53: 302-304, Feb. 1963.

A spectrographic survey, in the vacuum of ultraviolet, of Penning discharges in hydrogen, helium, neon, argon and krypton was carried out. The spectra show discreet lines in the wavelength range 160 to 720A and are quite free from background continuum radiation.

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Cornell U. [Dept. of Physics] Ithaca, N. Y.

X-RAY OSCILLATOR STRENGTHS OF THE 1s $\longrightarrow$ n p TRANSITIONS IN ARGON (Abstract), by T. Watanabe. [1962] [1]p. [AF 49(638)402] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 339, Apr. 23, 1962.

With Hartree-Fock wavefunctions, the oscillator strengths of 1s - 4p and 1s - 5p x-ray transitions were calculated. It was assumed that: (1) the effect of the 1s hole is simply to reduce electronic screening by unity so that the final state is essentially that of the excited potassium atom; (2) the remaining electrons retain essentially their respective radial positions upon production of the 1s hole; and (3) the coupling between the 1s hole and an np electron is small. The oscillator strengths, based on the dipole-moment expressions, were found to 0.0016 for the 1s - 4p and 0.00753 for the 1s - 5p transitions, respectively. Experimental values of these strengths from the latest measurements of K x-ray absorption spectra of argon are in good agreement with these calculated values. This agreement is interpreted as supporting the validity of the assumptions made. The use of Hartree-Fock wavefunctions in further calculations of atomic systems having a 1s-electron vacancy are encouraged.

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

A STUDY OF MAGNETOHYDRODYNAMIC INDUCTION DEVICES, by J. M. Lyons and D. L. Turcotte. Feb. 1962 [57]p. incl. diagrs. tables. (AFOSR-1864) (AF 49(638)544) AD 272082 Unclassified

The performance of a laminar-flow induction pump driven by a propagating sinusoidal magnetic field is investigated. It is assumed that the fluid is incompressible with scalar conductivity, that induced magnetic effects and the ratio of channel height to wave length are small, and that the magnetohydrodynamic interaction is large. No assumptions are made concerning the velocity profiles and no components of the magnetic fields are neglected. An inviscid solution containing the first-order perturbations due to induced currents and fringing of the applied magnetic field is obtained. Viscous effects are investigated and found restricted to boundary layers along the channel walls. Therefore, the inviscid results should be applicable to the inner core of a laminar-flow pump. It is concluded that the induced magnetic fields do not affect the performance of the pump to first order. However, the fringing of the magnetic field caused by separation of the pole pieces reduces the pump performance. The efficiency reduction is of the same magnitude as the laminar skin-friction loss. The relative reduction in pressure head is slightly greater than the reduction in efficiency. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

SOME ASPECTS OF MAGNETOHYDRODYNAMIC FLOW ABOUT A BLUNT BODY, by B. P. Leonard. June 1962 [56]p. incl. diagrs. refs. (AFOSR-2714) (AF 49(638)-544) AD 281879 Unclassified

Electromagnetic body forces are nonconservative. The effects of such forces are studied here in the case of inviscid incompressible flow about a blunt body. The nonlinear simultaneous partial differential equations

describing the flow can be solved in various regimes corresponding to certain values of 2 parameters: Rm, the magnetic Reynolds number, and A where A to the -1/2 power is the Alfven number. For the case of small Rm, and small magnetic force coefficient, S, equations can be derived which are linear and independent. These are solved for some particular unsteady flows, and the results show that, in these cases, vorticity is introduced in such a way that it is independent of time. The equations are linearized by using the velocity field of ordinary hydrodynamics (OHD) in the convective derivatives. This technique is valid for all Rm provided either A or S is small. For large Rm, it results in a solution showing a boundary-layer character. Two results are of interest. First, the appearance of the downstream non-diffusive trail of vorticity in the small Rm, small S case. Secondly, the fact that for all cases studied the region of significant current density is close to the body, and any wake-like effect is either highly diffusive (small Rm) or extremely weak (large Rm). (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THE THEORY OF ALIGNED-FIELDS MAGNETOGASDYNAMIC FLOWS, by A. R. Seebass. June 1962, 85p. incl. diagrs. refs. (AFOSR-2715) (AF 49(638)544) AD 281880 Unclassified

The isentropic flow of an ideal conductor in the presence of a magnetic field is treated for the case of aligned fields. Particular attention is paid to flow regimes where the existing linearized theory fails because of a change in character of the governing equations. The equations for the stream function and a new potential function are derived, and the behavior of their characteristics determined. These equations are then transformed to hodograph variables, in which they become linear. Several exact solutions are considered in detail. Separation of variables in these hodograph equations results in a complicated differential equation, which is discussed briefly. Finally, the approximate equations appropriate to each transition are derived, and simple solutions exhibiting these transitions are given. (Contractor's abstract)

784

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

AN EXPERIMENTAL STUDY OF THE SURFACE WAVES GENERATED BY A TIME VARYING MAGNETIC FIELD. Master's thesis, by G. C. Light. Feb. 1962 [45]p. incl. illus. diagrs. (AFOSR-2956) (AF 49(638)544) AD 277712 Unclassified

Surface waves have been generated on a circular pool of mercury by means of induced currents. A discharge through a pair of coaxial coils generates induced currents in the mercury; these currents in turn interact with the currents in the coils to produce a force. The geometry constitutes the free-surface analogy of the circular pinch. The height of the free surface is analogous to the density in an infinite column of compressible gas. In the experiments reported here, only weak disturbances are considered. A theoretical relation for the height of the disturbances is derived from the analogous gas-dynamic problem. The theory is in good agreement with the measured values of the disturbance height. The success of these initial experiments indicates the possibility of obtaining useful information on the containment problem by exploitation of the free-surface analogy. (Contractor's abstract)

785

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

STAGNATION POINT FLOW OF A VARIABLE PROPERTY FLUID AT LOW REYNOLDS NUMBERS, by M. Lenard. June 1962, 168p. incl. diagrs. tables. (AFOSR-2981) (AF 49(638)544) AD 404488 Unclassified

Steady viscous, 2-dimensional and axially symmetric stagnation-point flows of a gas are considered for the case when the Reynolds number is too low for the applicability of the classical boundary-layer theory. It is assumed that the low-density gas is still a continuous fluid, permitting the use of the Navier-Stokes and associated equations as the basis of the problem. The effects of low Reynolds number are determined by applying an expansion procedure to the fluid-dynamical equations. (Contractor's abstract)

786

Cornell U. Graduate School of [Aeronautical] Engineering, Ithaca, N. Y.

[THEORETICAL AND EXPERIMENTAL INVESTIGATIONS IN HIGH SPEED AERODYNAMICS] by W. R. Sears. Final rept. Nov. 1, 1959-May 1, 1962. Sept. 24, 1962, 6p. (AFOSR-3710) (AF 49(638)544) Unclassified

The results of the research carried out during the period of this project are summarized under the following headings: jet-flap theory, unsteady boundary-layer flow; gasdynamics with chemical effects; hypersonic flow, rarefied-gas dynamics; plasma dynamics; and magnetofluiddynamics. A list of 25 reports and publications resulting from the research is included.

787

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

A PERIODIC BOUNDARY-LAYER FLOW IN MAGNETOHYDRODYNAMICS, by D. L. Turcotte and J. M. Lyons. [1962] [10]p. incl. diagrs. (AFOSR-4245) (AF 49(638)-544) Unclassified

Also published in Jour. Fluid Mech., v. 13: 519-528, Aug. 1962.

An attempt is made to solve a boundary-value problem posed by induction electromagnetic pumps and generators. Solutions are obtained by an expansion technique and a

momentum method for the laminar, incompressible flow problem. For large values of the interaction parameter ($\mu^2\sigma H_0^2\lambda/\rho u_e$) viscous effects are shown to be restricted to periodic boundary layers. In regions of high-field strength, a local Hartmann solution is valid. Where the applied field is weak an inertial boundary layer is present which thickens in the upstream direction. A logical explanation of this phenomenon is given. The condition that a boundary-layer type flow exist is obtained and is shown to be in general satisfied. The results show that inviscid theory may be used to calculate the overall performance of electromagnetic pumps and generators while the boundary-layer theory developed here may be used to obtain the wall shear stress. (Contractor's abstract)

788

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

ELECTRICAL RESISTANCE AND SHEATH POTENTIAL ASSOCIATED WITH A COLD ELECTRODE, by D. L. Turcotte and J. Gillespie. [1962] [7]p. incl. diagrs. refs. (AFOSR-5121) (AF 49(638)544) AD 438558 Unclassified

Presented at Seventeenth annual meeting of the Amer. Rocket Soc., Los Angeles, Calif., Nov. 13-18, 1962.

Also published in AIAA Jour., v. 1: 2293-2299, Oct. 1963.

The boundary-layer resistance and the difference in sheath potentials between a pair of electrodes have been measured in a shock tube. Using a small, square electrode and a strip electrode flush with the wall of the shock tube, the electric current that could be drawn across the shock tube was measured as a function of the shock wave position for several applied voltages and load resistances. All measurements were made in air at a shock speed of 4.35 mm/μ sec and an initial pressure of 1 mm Hg. In the range of applied voltages considered, the boundary-layer resistance was not a function of the current level. The change in the sheath potential was of the order of several volts. A continuum theory is developed to predict the boundary-layer resistance for small current levels and the sheath potential. The sheath solution is separated from the convective compressible boundary-layer problem where ambipolar diffusion dominates. In the sheath, the transport equations for ions and electrons in an electric field are solved numerically. Resulting integrals for the dimensionless boundary-layer resistance and sheath potential are evaluated, both in the sheath and in the compressible boundary layer, to obtain results that can be compared with experiment. Values of the resistance obtained assuming the ionization reaction to be frozen, are not in agreement with experiment. Reasonable agreement between theory and experiment is obtained for the magnitude of the sheath potential. (Contractor's abstract)

789

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

STRUCTURE OF COLLISION-FREE MAGNETOHYDRODYNAMIC WAVES, by T. A. Wilson. [1962] [5]p. incl. diagrs. (AFOSR-J734) (AF 49(638)544) AD 414078 Unclassified

Also published in Phys. Fluids, v. 5: 1451-1455, Nov. 1962.

Properties of the 2-fluid plasma equations which lead to a partial theoretical model for the collisionless shock wave are investigated. First, a nonlinear symmetric-pulse solution to the 2-fluid equations for a cold collisionless plasma is described. The propagation speed of the pulse is between the Alfvén speed and the fast-wave speed, and the pulse thickness is of the order of $(m_i c^2/4\pi e^2 N)^{\frac{1}{2}}$, except for geometries in which the wave normal makes an angle of the order of $(m_e/m_i)^{\frac{1}{2}}$ or less with the upstream magnetic field. An effective conductivity is then introduced in the equations of motion of the plasma and a shock thickness is estimated. The calculated dependence of shock thickness on Mach number is shown to agree with the available experimental data. Finally, the growth of a sinusoidal pinch instability of a current-carrying plasma is shown to have the average effect of a finite conductivity as was postulated. (Contractor's abstract)

790

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

CURRENT-LAYER DIFFUSION IN A ONE-DIMENSIONAL PINCH, by T. J. Falk and D. L. Turcotte. [1962] [5]p. incl. diagrs. refs. (AFOSR-J735) (AF 49(638)544) AD 414120 Unclassified

Also published in Phys. Fluids, v. 5: 1288-1292, Oct. 1962.

Diffusion of the current layer at the surface of a compressible electrically conducting gas in a 1-dimensional pinch is analyzed in the limit of large time. Magnetohydrodynamic equations including finite scalar electrical and thermal conductivities are used, and the degree of ionization is taken to be constant. A parameter, which is proportional to the diffusion speed divided by the sound speed, is used to show that the inertia terms may be discarded in large-time high-electrical-conductivity problems. Some numerical results for the temperature, velocity, and magnetic field within the current layer are presented in terms of a similarity variable. In the cases analyzed, the gas boundary is displaced from its infinite conductivity position by an amount which is of the order of magnitude of the current-layer thickness. Comparison of constant conductivity with temperature-dependent conductivity results shows that Joule heating at the gas boundary improves confinement if the initial conductivities are low.

791

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THE PITCHING-MOMENT COEFFICIENT OF A JET-FLAPPED THIN AIRFOIL, by J. C. Erickson, Jr. [1962] [2]p. incl. table. (AFOSR-J736) (AF 49(638)544) AD 414145 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 1489-1490, Dec. 1962.

Spence recently found the lift coefficient of a jet-flapped thin airfoil. To complete the results, the present note outlines the calculation of analytic expressions for the pitching-moment coefficients of such airfoils. These expressions agree well with the numerical results of D. A. Spence.

792

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

A GENERAL TRANSFER-EQUATION APPROACH FOR THE TRANSITION REGIME OF RAREFIED-GAS FLOWS AND SOME OF ITS APPLICATIONS, by S. F. Shen. [1962] [20]p. incl. diagrs. table, refs. (AFOSR-J1045) (AF 49(638)544 and AF AFOSR-62-201) Unclassified

Also published in Rarefied Gas Dynamics, Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, 1963, Suppl. 2, v. 2: 113-131, 1963. (AFOSR-5310)

For solving the boundary-value problem of the Boltzmann equation at arbitrary Knudsen number, it is proposed to use the transfer equations with approximate distribution functions that exhibit the proper collision effects. Such a distribution function is deduced by an elementary analysis of the simpler Krook equation. It may be regarded as of the relaxation type, changing from the free-molecule limit to the continuum limit exponentially with the number of collisions. Applications to the linearized plane and cylindrical Couette flows are made. Though more cumbersome than earlier, simpler approaches, the present theory is fundamentally more defensible and seems to yield better details in the Knudsen layer. (Contractor's abstract)

793

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

A THEORY FOR UNSTEADY MOTIONS OF JET-FLAPPED THIN AIRFOILS, by J. C. Erickson, Jr. Sept. 1962. 200p. incl. refs. (AF 49(638)544) AD 407504 Unclassified

A linearized model for the incompressible, inviscid, irrotational, and unsteady flow about a thin airfoil with jet-flap is formulated. The unsteady problems considered are the transient and oscillatory deflection of the jet, plunging and pitching of the airfoil, deflection of a blown-flap, and also the penetration of a sharp-edged gust. Justification is given for representation of the jet, in the limit of high speed, small thickness, and constant momentum-flux strength, by a vortex sheet, across which there is a pressure difference proportional to the momentum-flux strength and inversely proportional to the local radius of curvature of the jet. The dynamic and kinematic interaction of the main stream with the vortex sheets representing the airfoil and jet are shown to be described by a coupled set of equations consisting of a third-order partial differential equation and a singular integral equation, along with appropriate boundary conditions. The properties of these equations and their relationship to classical unsteady thin-airfoil theory and steady jet-flap theory are discussed.

794

Cornell U. Graduate School of Aeronautical Engineering, Ithaca. N. Y.

TRANSONIC FLOW OF A PERFECTLY CONDUCTING GAS WITH ALIGNED MAGNETIC FIELD, by K. Tamada. [1962] [8]p. incl. diagrs. (AFOSR-4247) (AF 49(638)-674) Unclassified

Also published in Phys. Fluids, v. 5: 871-878, Aug. 1962.

The 2-dimensional transonic flow of a perfectly conducting, inviscid, compressible fluid past thin body with aligned magnetic field is studied by developing a small-perturbation theory in the hodograph plane. It is shown that the equations of motion as well as the conditions for possible shock waves can be reduced to those of ordinary flow by a suitable affine-transformation. Thus, von Kármán's transonic similarity law is extended to the present class of magneto-gas-dynamic flow. In this extension, super-Alfvénic flows (flow speed larger than Alfvén wave speed) are found to be similar to the corresponding ordinary flow, while sub-Alfvénic flows are related to the ordinary flow with reversed flow direction. The flow over a half-wedge at Mach number 1 is considered in detail. (Contractor's abstract)

795

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

FLOW OF A SLIGHTLY CONDUCTING FLUID PAST A CIRCULAR CYLINDER WITH STRONG, ALIGNED MAGNETIC FIELD, by K. Tamada. [1962] [7]p. incl. diagrs. refs. (AFOSR-4248) (AF 49(638)674) Unclassified

Also published in Phys. Fluids, v. 5: 817-823, July 1962.

The induced magnetic field is neglected owing to the small conductivity of the fluid. The effect of the magnetic field upon the flow is also assumed to be so small that it can be treated as a perturbation. Thus, the first-order correction to the nonmagnetic potential flow is obtained by a simple perturbation technique. The solution indicates existence of a nondiffusive, vortical, velocity deficiency which extends indefinitely downstream of the

cylinder. The flow field at great distances is also reconsidered as a problem of singular perturbation. (Contractor's abstract)

796

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

MAGNETOGASDYNAMIC FLOWS WITH SHOCK WAVES, by N. Geffen. [1962] [5]p. incl. diagrs. refs. [AF 49-(638)674] Unclassified

Published in Phys. Fluids, v. 6: 566-571, Apr. 1963.

A consistent small-perturbation theory for the aligned-fields, steady, magnetogasdynamic 2-dimensional and axisymmetric flow of an inviscid conductor in the sonic, Alfvénic, and hypercritical regimes is developed, and approximate shock relations derived by a simple method. This results in nonlinear relatively simple systems of equations and shock relations for mixed flows around bodies in the transition regimes. It is found that transonic magnetogasdynamic problems can be reduced to gasdynamic ones; each gasdynamic transonic flow around a given body implies an infinite number of magnetogasdynamic patterns around the same body for all values of Alfvén numbers different from zero and one, and each of these, in turn, yields another family of flows around similar bodies, according to a modified von Kármán similarity rule. The hypercritical and transonic systems are mathematically similar and obey the same similarity rule. An explicit correspondence between specific transonic and hypercritical flows does not exist, but transonic arguments and methods can be used to infer qualitative properties of hypercritical flows and to obtain exact solutions of hypercritical flow patterns. (Contractor's abstract)

797

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

INVESTIGATION OF CONDENSATION PROCESSES BEHIND NORMAL SHOCKS BY OPTICAL METHODS—A FEASIBILITY ANALYSIS, by Y. Timnat and S. H. Bauer. Mar. 1962 [19]p. incl. diagrs. tables, refs. (AFOSR-2789) (AF 49(638)716) AD 274515 Unclassified

The objective of this report is to analyze the conditions under which solid particles, formed in a shock tube by thermal decomposition of selected compounds, may be detected and to propose experimental methods for determining the induction time for the initial condensation, the number of particles formed per unit volume, and their rate of growth. Examples of substances which are proposed for experimental study are benzene, lead tetraethyl, and chromium carbonyl. The principles of light scattering by small particles are reviewed briefly in Section I and their application to condensation problems in a shock tube is dealt with in Section II. An analysis of the second parameter to be measured is presented in Section III, and in the final section, specific proposals for experiments are discussed, taking into account a few order of magnitude results which have been obtained.

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

MECHANISMS FOR VIBRATIONAL RELAXATION AT HIGH TEMPERATURES, by S. H. Bauer and S. C. Tsang. Apr. 1962 [21]p. incl. diagrs. refs. (AFOSR-2790) (AF 49(638)716) AD 274467 Unclassified

Also published in Phys. Fluids, v. 6: 182-189, Feb. 1963.

Attention is called to several mechanisms which effectively couple translational and vibrational motions through the intermediary of chemical reactions. It was proposed that these processes lead to shorter relaxation times than those expected from direct energy exchange via inelastic collisions. Semiquantitative estimates were made, and relaxation times for these different processes were compared as a function of the reciprocal temperatures. At high temperatures, it was proposed that the transfer of energy from rotations to vibrations at approximately constant total energy could be induced by distant collisions. These serve only to balance the change in rotational angular momentum. Such events provide alternate paths for rapid vibrational relaxation, particularly for the upper vibrational levels, and may account for the discrepancy between the observed and calculated rates of dissociation. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

RATE OF DECOMPOSITION OF AZOMETHANE IN A SHOCK TUBE, by G. Chiltz, C. F. Aten, Jr., and S. H. Bauer. [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-3675) (AF 49(638)716) Unclassified

Also published in Jour. Phys. Chem., v. 66: 1426-1431, Aug. 1962.

The prolysis of azomethane was studied in a shock tube over the temperature range 800° to 1300°K. Concentrations of the azomethane of 1-3% in argon were used. The rate of decomposition in the incident shock region was followed spectrophotometrically at λ 338 mμ. It was estimated that under shock conditions the depletion of the reactant via a chain mechanism was negligible compared to that due to the unimolecular decomposition. Due to the exothermicity of the over-all reaction (products, N_2 and C_2H_6), only average rate constants could be evaluated from the recorded oscilloscope traces. These were found to fall well within the extrapolations of the 2 most recent low-temperature studies, based on a strict Arrhenius temperature dependence. (Contractor's abstract)

800

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

STUDIES WITH A SINGLE-PULSE SHOCK TUBE. I. THE CIS-TRANS ISOMERIZATION OF BUTENE-2, by A. Lifshitz, S. H. Bauer, and E. L. Resler, Jr. [1962] [8]p. incl diagrs. tables, refs. (AF 49(638)716) Unclassified

Published in Jour. Chem. Phys., v. 38: 2056-2063, May 1, 1963.

The cis-trans isomerization of butene-2 was investigated behind reflected shocks in a single-pulse shock tube of a novel design. The temperature range covered was 1000° to 1250°K. and concentrations of 1% and 6% of the butene in argon were used. Analyses were made by vapor-phase chromatography. The first-order rate constants obtained in this work fall slightly above the extrapolated Arrhenius curves of 2 recent low-temperature studies. An activation energy of 65, rather than 62.8 kcal/mol, is obtained when a straight line is drawn between the high and the low temperature data. The rate constant obtained is $k_{cis} = 3.5 \times 10^{14} \exp(-65 \times 10^3/RT)$. Possible sources of errors in evaluating reaction times in the single-pulse shock tube are discussed. (Contractor's abstract)

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Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

MAGNETO-FLUID-DYNAMIC NOZZLE FLOW, by W. R. Sears, A. R. Seebass, and S. G. Rubin. [1962] [6]p. incl. diagrs. table, refs. (AFOSR-J1034) [AF AFOSR-62-201] Unclassified

Also published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 827-832.

Studies are reported of both crossed-fields and aligned fields channel flows to ascertain whether and under what conditions the various transitions between elliptic and hyperbolic behavior can be crossed smoothly in steady flow and whether such nozzle and diffuser flows are stable to propagating disturbances. Within the limits of various necessary approximations it is concluded (1) that smooth transitions occur in steady flow provided that choking at the speed of sound is avoided by meeting necessary design conditions, (2) that the resulting nozzle flows are stable to sufficiently small disturbances, (3) that aligned-field diffusers are unstable at the speed of sound and may also be unstable at the Alfvén speed, and (4) that crossed-field diffusers are generally unstable at a critical supersonic speed but may be stabilized by a divergence of area and the presence of a strong magnetic field. (Contractor's abstract)

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Cornell U. Lab. of Atomic and Solid State Physics, Ithaca, N. Y.

INVESTIGATION OF SOLID SURFACES BY FIELD EMISSION MICROSCOPY AND MASS SPECTROMETRY, by R. C. Bradley. Final rept. Feb. 1, 1960-Jan. 31, 1962, Mar. 1, 1962, 14p. incl. refs. (AFOSR-2273) (AF 49(638)748) AD 276727 Unclassified

The physics of surface phenomena on metals under ultra high vacuum conditions or in controlled pure gas atmospheres of argon, xenon, oxygen and nitrogen were studied. A bakeable mass spectrometer was designed and built specifically for this purpose. An investigation was made of the mechanisms of sputtering, evaporation and desorption from molybdenum, tantalum, platinum and copper. Additional information was obtained on electron emission phenomena from zirconium and some of its alloys with the field emission microscope. (Contractor's abstract)

803

Cranfield Coll. of Aeronautics [Bletchley, Bucks] (Gt. Brit.).

THEORETICAL AND EXPERIMENTAL STUDY OF HEAT AND MASS TRANSFER FROM NON-ISOTHERMAL SURFACES, by A. G. Smith and V. L. Shah. Nov. 1962 [74]p. incl. illus. diagrs. tables, refs. (CoA note no. 135) (AFOSR-4755) (AF 61(052)267) AD 409624 Unclassified

The numerical solution of the partial differential equation in the incompressible turbulent boundary layer has been obtained for step $\frac{q''w}{\rho u_1 C_p \sqrt{Q_1/2}}$ and for Prandtl numbers 0.7, 1 and 7. The Schmidt method of integration was used and the integration was carried out on a Ferranti Pegasus digital computer. A method has been developed to apply this numerical solution for obtaining surface and fluid temperature for the case of arbitrary distribution of heat flux at the surface. Simultaneously approximate equations for calculating heat transfer over a flat plate with arbitrary heat flux are derived for laminar and turbulent flow. To verify the theoretical solution, experiments were made in which the concentration profiles of the injected gas (carbon dioxide) at different stations were measured when the pipe had another gas (air) flowing turbulently through in the axial direction, and the gas injected was passed through a porous section of the tube wall. (Contractor's abstract)

804

Cranfield Coll. of Aeronautics [Bletchley, Bucks] (Gt. Brit.).

THE CALCULATION OF WALL AND FLUID TEMPERATURES FOR THE INCOMPRESSIBLE TURBULENT

BOUNDARY LAYER, WITH ARBITRARY DISTRIBUTION OF WALL HEAT FLUX, by A. G. Smith and V. L. Shah. [1962] [11]p. incl. diagrs. tables. (AF 61(052)267)
Unclassified

Published in Internat'l. Jour. Heat and Mass Transfer, v. 5: 1179-1189, Dec. 1962.

Numerical solution of the partial differential equation for heat transfer in the incompressible turbulent boundary layer has been obtained for uniform ($\ddot{q}_w$ o$C_p u_1 c_f/2$) and for Prandtl numbers 0.7, 1 and 7. The Spalding boundary-layer velocity law was assumed, and the Schmidt method of integration used. Boundary-layer temperature distributions up to $x^+ = 10^6$ are presented, together with the "Spalding function" St $\sqrt{2/c_f}$. A method is given for the application of the solutions to the case of arbitrary distribution of heat flux at the wall. (Contractor's abstract)

Cruft Lab., Cambridge, Mass.
see Harvard U. Cruft Lab., Cambridge, Mass.

805

Delaware U. [Dept. of Chemical Engineering] Newark.

['THE OXIDATION OF IRON AND ITS ALLOYS AT HIGH TEMPERATURE] L'oxydation du fer et de ses alliages a haute température, by C. E. Birchenall. [1962] [9]p. incl. refs. (AFOSR-64-0759) (AF AFOSR-62-174) AD 438241 Unclassified

Presented at Conf. Internationale des Arts chimiques, (Apr. 25-May 4, 1962), Paris (France).

Also published in Corrosion et Anticorrosion, v. 10: 319-327, Oct. 1962.

The mechanism and kinetics of the oxidation of pure iron are outlined by experiments which show the principal process of diffusion interfering in the growth of each layer of oxide, the sulfurization of iron and the effects of cracks and pores. The effects of the oxidizing gas and of the constituents on Fe-O system were studied. The importance of the mobility of the cations is explained. The ductibility of the corrosion of the corrosion film depends on the mobility of the ions which cause the growth, since the creep of a higher oxide is governed by ionic diffusion. Recent results concerning the effects of magnetic phenomena on the diffusion of Fe and its alloys are given.

806

Delaware U. Dept. of Chemistry, Newark.

MADELUNG CONSTANTS FOR THE CALCIUM CARBIDE AND PYRITE CRYSTAL STRUCTURES, by R. Wood. [1962] [3]p. incl. tables, refs. (AFOSR-2105) (AF 49(638)1054) AD 611381 Unclassified

Also published in Jour. Chem. Phys., v. 37: 598-600, Aug. 1, 1962.

The Madelung constants for the calcium carbide and pyrite crystal structures have been calculated assuming that the anion can be represented by 2 spherically symmetric charge distributions. The results indicate that the assumption that the anion is spherically symmetric can lead to small errors in the case of the pyrite structure and large errors in the case of the calcium carbide structure. (Contractor's abstract)

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Delaware U. [Dept. of Psychology] Newark.

THE NEWCOMER'S ACCEPTANCE IN OPEN AND CLOSED GROUPS, by R. C. Ziller. [1962] [8]p. (AFOSR-J425) (AF AFOSR-62-95) AD 407716 Unclassified

Also published in Personnel Admin., v. 25: 24-31, Sept.-Oct. 1962.

Results indicate that closed groups and those which have a history of success are likely to reject the ideas of knowledgeable outsiders. It is proposed that groups with less well-defined boundaries, as opposed to those with well-defined boundaries, are more amenable to membership changes. It is hypothesized that a broadly defined group can embrace a greater variety of persons than a narrowly defined group, and the cost to the group in the process of establishing the newcomer is diminished. Implications for group survival are discussed.

808

Documentation, Inc., Bethesda, Md.

FORMAL RESULTS IN THE LOGIC OF EXISTENCE, by R. M. Jones. [1962] [4]p. (AFOSR-3227) (AF 49(638)-1146) AD 440039 Unclassified

Also published in Philos. Studies, v. 15: 7-10, Jan.-Feb. 1964.

Some results concerning existence in mathematical logic are discussed. It is suggested that some of the proofs are not acceptable in the logic of existence. It would seem that Leonard's system of logic would either reject the view that it is contingent that something exists or hold that the logic of existence is a logically impure mixture of necessary and contingent principles.

809

Documentation, Inc., Bethesda, Md.

A NOTE ON OBVERSION, by R. M. Jones. [1962] [2]p. (AFOSR-J244) [AF 49(638)1146] Unclassified

Also published in Mind, v. 71: 541-542, Oct. 1962.

Recently a logic has been proposed by Leonard that admits singular terms that denote nothing. In such a logic there is a certain problem concerning obversion. Suppose that statements of the form fx are interpreted in such a way that they are true if and only if the term that plays the role of x denotes something to which the term that plays the role of f is applicable, but false if the condition is not fulfilled. Consider the following 2 sentences: (1) ~ Mc and (2) $\hat{x}$(~ Mx)c. A logic that allows non-denoting terms can without harm permit an inference from (2) to (1), since in this case the premise is false if the singular term in question does not denote, while the inference is valid in the usual way if that term does denote. The difficulty of disallowing an inference such as that from (1) to (2) can be met by adopting Quine's device of construing all singular terms as abbreviations for definite descriptions. This device will not, however, meet the following difficulty which is very similar to the one above concerning obversion. Consider the sentence "Pericles worshipped Zeus" which might be abbreviated as follows: (3) Wpz. By a logical principal very similar to that by which one passes from (1) to (2), we may pass from (3) to: (4) $\hat{x}$(Wpx)z. If we still hold to the first agreement above concerning the conditions under which a statement of the form fx is true, then (4) is false since z denotes nothing. If the device of taking all singular terms as abbreviations for definite descriptions is adopted, then (3) and (4) have the same truth value, and all such statements as (3) are false.

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Dublin U. Coll. (Ireland).

THE NATURE OF SODIUM EXCHANGES IN ISOLATED FROG SARTORII, by D. Conway, M. G. Harrington, and M. Mullaney. [1962] [20]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)435] and Public Health Service) Unclassified

Published in Jour. Physiol. (London), v. 165: 246-265, Feb. 1963.

The entrance of Na ions into isolated frog sartorii has been studied at approx 0°C and over a 24 hr period. The external fluid was of the Ringer-Conway type. The Na content was usually 120 mM and the K content was varied from 0 to 20 mM. With an external Na of 120 mM and a K content of 0 or 2.5 mM, the net entrance of Na ions occurred in 2 phases. Phase 1 brought the Na content to about 40 m-equiv/kg and was ended in 3-4 hr. Phase 2, after a further 20 hr, brought the muscle to about 50-59 m-equiv/kg. The inclusion of ouabain in the external fluid had no appreciable effect on the Na entrance. With an external K value of 5 mM or more, the first phase is decreased and the second phase does not occur. Evidence is presented indicating that the first phase of such Na entrance arises from increased permeability involving an outer compartment of the fibers, or the whole fiber in a special group, while the second phase of Na entrance occurs through pores of normal dimensions into an inner compartment of the fiber. Normally the outer compartment, if this exists, would appear only as a potential space. From studies of the membrane potentials, potassium and water content, and interfiber space measurements, additional evidence is presented for the Conway membrane theory. It is shown that the recent results of Steinbach, using the sartorii of the Rana pipiens, provide further evidence for the concept of a critical energy barrier to the secretion of Na ions from Na-loaded sartorii.

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Duke U. [Dept. of Mathematics] Durham, N. C.

SOLUTIONS OF THE EQUATIONS OF THERMOELASTIC EQUILIBRIUM, by I. N. Sneddon. [1961] [13]p. incl. refs. (AFOSR-J728) (AF 18(600)1341) AD 413968 Unclassified

Also published in Arch. Mech. Stosowanej, v. 14: 113-125, 1962.

A solution is given of the equations of thermoelastic equilibrium appropriate to problems in which the conditions $\tau_{xz} = \tau_{yz} = 0$, on $z = 0$, are imposed. It is not assumed that the normal component of stress is zero. It is shown that the stress and temperature fields can be expressed in terms of 3 harmonic functions ϕ, ψ, and χ. Lurye's solution is shown to be derivable from this general solution by taking $\chi = 0$ and making ψ proportional to $\partial\phi/\partial z$. The form of solution for problems with axial symmetry is derived and solutions suitable for the analysis of problems about semi-infinite solids, semi-infinite circular cylinders, and elastic layer are written down. Finally, solutions of 2-dimensional problems are discussed.

812

Duke U. [Dept. of Mathematics] Durham, N. C.

RESEARCH IN PARTIAL DIFFERENTIAL EQUATIONS, by J. J. Gergen. Final rept. Feb. 23, 1962, 7p. (AFOSR-2224) (AF 49(638)892) Unclassified

A summary of research done on partial differential equations is presented. Topics considered include: the applied mathematics aspects of partial differential equations, the perturbation of 1-parameter group unitary representations, and Poisson approximating functions. In addition, the following theorem is proved: A compact near-ring with zero radical is the complete cartesian product of a family of finite simple near-rings.

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Duke U. [Dept. of Mathematics] Durham, N. C.

WEAK EIGENVECTORS AND THE FUNCTIONAL CALCULUS, by R. T. Harris. [1962] [18]p. incl. refs. (AFOSR-3141) (AF AFOSR-61-51) AD 436179 Unclassified

Also published in Trans. Amer. Math. Soc., v. 109: 367-384, Dec. 1963.

This article constitutes a substantial generalization of the theory of weak eigenvectors defined by extensions of a space. Let $D \subset E \subset E' \subset D'$ be separable Banach spaces; let $\mathfrak{R}$ be the set of strongly continuous representations of the additive group of reals in $L(E)$, $\mathfrak{R}$ the set of $r \in \mathfrak{R}$ such that $p_r(t) = |r(t)|_{L(D, D')}$ is integrable and $\langle r(t)a, b\rangle$ is integrable for each $a, b \in D$, $\mathfrak{R}_1$ the subspace for which $|r(t)|_{L(E)}$ is continuous and $\int (\log^+ |r(t)|/(1+t^2))\, dt < \infty$. Let $w_r(t) = \sup(|r(t)|_{L(E)}, |r(-t)|_{L(E)}, 1)$ and let $\mathfrak{S}(r)$ be the algebra of functions f which are each Fourier transforms of a measure m_f on the line such that $\int w_r\, dm_f < \infty$. If N is dense in D and $r(t)N = N$, then $\mathfrak{E}_\lambda$ is the set $\{e : e \in D', \langle r(t)a, e\rangle = e^{i\lambda t}\langle a, e\rangle\}$ for all $a \in N$, and $\mathfrak{E}_\lambda$ is the set of λ for which $r(t)e = e^{i\lambda t}e$. If $r \in \mathfrak{R}$, $f \in \mathfrak{S}(r)$, then $T_f x = \int f(t)x\, dm_f(t)$ defines a transform on E such that T_f commutes with $r(t)$ and $f \to T_f$ is a continuous homomorphism to a subalgebra of $L(E)$. If $r \in \mathfrak{R}$, there is a unique map $\lambda \to T_\lambda \in L(D, D')$ such that $\int f\langle a, T_\lambda b\rangle\, d\lambda = \langle T_f a, b\rangle$ if $f \in \mathfrak{S}(r)$. If $r \in \mathfrak{R}$, $f \in \mathfrak{S}(r)$, $e \in \mathfrak{E}_\lambda$, then $T_f e = f(\lambda)e$; the set $\mathfrak{E}_\lambda$ corresponds to the set of eigenvectors, the set of λ such that $\mathfrak{E}_\lambda \neq 0$ to the spectrum. Similarities between the spectral properties of $r \in \mathfrak{R}_1$ and those for

spectral operators of scalar type are exhibited. It is proved also that if $r \in S$, the range of T_λ is contained in $\mathfrak{R}_\lambda$, and for operators of cyclic type this range is $\mathfrak{S}_\lambda$. Representation theorems for subunitary operators and other concrete examples are given. (Math. Rev. abstract)

814

Duke U. [Dept. of Mathematics] Durham, N. C.

CONVERGENCE OF EXTENDED BERNSTEIN POLYNOMIALS IN THE COMPLEX PLANE, by J. J. Gergen, W. G. Dressel, and W. H. Purcell, Jr. [1962] [10]p. incl. refs. (AFOSR-64-0730) (AF AFOSR-61-51) AD 436515 Unclassified

Also published in Pacific Jour. Math., v. 13: 1171-1180, 1963.

The following theorem is proved: Suppose that $f(z)$ is analytic and has property B in p(d), where d is a positive number. Then the functions $P_k(z;f) = e^{-kz} \sum_{\lambda=0}^{\infty} \frac{(kz)^\lambda}{\lambda!} f\left(\frac{\lambda}{k}\right)$, $0 < k$, satisfy the following 4 conditions. (1) $P_k(z;f)$ is an entire function of z for each k. (2) $P_k(z;f) \to f(z)$ as $k \to \infty$ in p(d). (3) The convergence in (2) is uniform on each compact subset of p(d). (4) The functions $\{P_k(z/X_k;f)\}_{0<k}$, where $X_k = \exp[1/(2k)]$, have property B uniformly in p(d).

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Duke U. Medical Center, Durham, N. C.

PSYCHOPHYSIOLOGICAL STUDIES IN ALTERED SENSORY ENVIRONMENTS, by S. I. Cohen, A. J. Silverman, and B. M. Shmavonian. [1962] [23]p. incl. diagrs. tables, refs. (AFOSR-J372) (AF 49(638)354) AD 403612; AD 406452 Unclassified

Presented at Fifth European Conf. for Psychosomatic Research, Apr. 23, 1962, Madrid (Spain).

Also published in Jour. Psychosomat. Research, v. 6: 259-281, 1962.

Body- and field-oriented subjects were tested for 2 hr in a low sensory input experiment. Subjects who were field-oriented showed (1) the most intense psychological discomfort; (2) a higher incidence of visual and auditory imagery; (3) more evidence of disorganization of thought; (4) greater discomfort with body sensations; (5) less ability to discriminate somato-sensory cues; and (6) EEG and skin resistance evidence of a higher level of alerting. Next, subjects received either a sedative, stimulant, or placebo capsule and were tested in the same manner. The response patterns of both groups with a placebo were similar to those observed in the previous experiment. The response of the subjects to the sedative and to the stimulant was different in that the field subjects showed a decrease in central nervous system activation and a more relaxed psychological state as the experiment progressed while body subjects showed alerting to the stimulant and mixed response to sedative. Hence, altering the internal state of the 2 subjects changed their response patterns to the experimental environment. In another study the responses of subjects given LSD during a 2-hr low sensory input experiment were compared to responses of subjects given a placebo. The effects in the LSD subjects were very similar to the responses of field subjects in the previous study. Possible neurohormonal and neurophysiological differences in addition to perceptual mode and personality differences in body- and field-oriented subjects are discussed. The possible application of the experimental results to clinical diagnostic and therapeutic problems and selection and training problems in aerospace research are reviewed.

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Duke U. Medical Center, Durham, N. C.

PERCEPTUAL AND ENVIRONMENTAL INFLUENCES ON PSYCHOPHYSIOLOGICAL RESPONSES, by A. J. Silverman, S. I. Cohen, and B. M. Shmavonian. [1962] [18]p. incl. tables, refs. (AFOSR-J699) (AF 49(638)-354) AD 413630 Unclassified

Also published in Recent Advances in Biological Psychiatry; Proc. of the Seventeenth Annual Convention and Scientific Program of the Society of Biological Psychiatry, Toronto (Canada) (May 4-6, 1962), ed. by J. Wortis. New York, Plenum Press, v. 5: 347-364, 1963.

Body (field-independent) and field (field-dependent) subjects were exposed to 2 experiments characterized by uncertainty, immobility, social isolation, and low sensory inputs. In the second experiment a pill (either a stimulant, sedative, or placebo) was given just before the experiment began. Field subjects remained more aroused than body subjects during the 2-hr experiment. Middle subjects were least aroused in general. Interview data revealed more evidence of ego disorganization among field subjects with more discomfort and restlessness, projection, imagery, and time distortion. Field subjects with placebo show more CNS activation than body subjects with placebo. The effect of the pill in this experimental setting appeared to be a general lowering of CNS activation. This lowering was more pronounced in the body than in the field group. Field subjects are more sedated with a sedative than body subjects. Field subjects show decreased CNS activation with a stimulant; body subjects show increased activation. Body subjects show more activation with stimulant and less activation with sedative than with placebo. Field subjects show most activation with placebo. The effects of perceptual and environmental influences on pre-experimental population differences were discussed.

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Duke U. [Microwave Lab.] Durham, N. C.

[MICROWAVE-MILLIMETER AND RADIO FREQUENCY

SPECTROSCOPY], by [W. Gordy]. Final rept. Oct. 12, 1959-Jan. 31, 1962 [21]p. incl. diagrs. refs. (AFOSR-2310) (AF 49(638)765) Unclassified

A bibliography of 106 papers published under the contract is given. One technical report and 7 abstracts of meeting presentations are bound with this final report.

818

Duke U. [Microwave Lab.] Durham, N. C.

MILLIMETER WAVE MOLECULAR BEAM SPECTROSCOPY: ALKALI BROMIDES AND IODIDES, by J. R. Rank and W. Gordy. [1962] [14]p. incl. illus. diagrs. tables, refs. (AFOSR-3931) [AF 49(638)765] Unclassified

Also published in Phys. Rev., v. 127: 817-830, Aug. 1, 1962.

The pure rotational spectra of the alkali bromides and the alkali iodides were investigated in the 1.5 to 5.0 mm range of the microwave region. The experiment was performed by passing a beam of molecules in the vapor state from an oven, capable of producing temperatures up to 1000°C, into an oversized section of wave guide so that the direction of incident microwave radiation was at right angles to the flow direction of the molecular beam. In this way linewidths less than 100 kc/sec at 100,000 mc/sec were easily achieved. The line frequencies were measured with a precision better than one part in 10^6. The apparatus was developed as a series of modifications on an earlier experiment. Dunham's theory for diatomic molecules was applied in interpretation of the data. In most cases, the values for B_e, α_e, and γ_e were known although less accurately, but D_e and β_e were found for the first time. From the latter two, accurate determinations were made for the first time of ω_e and $\omega_e x_e$. From these values, information has been obtained about the potential functions, which suitably describe these diatomic alkali halides. In addition, centrifugal distortion constants, isotope mass ratios, moments of inertia, and internuclear distances have been accurately evaluated for each molecule. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

ENERGY MIGRATION AND TRANSFER IN SOLID ARGON AND KRYPTON AT LOW TEMPERATURES, by W. V. Bouldin, R. A. Patten, and W. Gordy. [1962] [3]p. incl. diagrs. (AFOSR-3932) [AF 49(638)-765] Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 98-100, Aug. 1, 1962.

γ-irradiation of small concentrations of methane (or heavy methane) in an argon or krypton matrix at 4.2°K gives unexpectedly intense H (or D) and CH_3 (or CD_3) electron spin resonance signals. It is suggested that the matrix transfers energy to the impurity but a satisfactory explanation of the mechanism has not been found.

820

Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF N-CARBAMYL GLYCINE, by D. V. G. L. Narasimha Rao and M. Katayama. [1962] [3]p. incl. diagrs. tables. (AFOSR-3933) (AF 49(638)-765) Unclassified

Also published in Jour. Chem. Phys., v. 37: 382-384 July 15, 1962.

The electron spin resonance spectra of γ-irradiated single crystals of N-carbamyl glycine have been measured at 9 and 23 kmc/sec for various orientations of crystals in the external magnetic field. The proposed structure of the free radical produced by γ-irradiation is determined by the analysis of the hyperfine-interaction constants. The spin density at the carbon atom is 75% and the free radical is similar to that produced from acetyl-glycine and glycylglycine. (Contractor's abstract)

821

Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF A γ-IRRADIATED SINGLE CRYSTAL OF N-ACETYL METHIONINE, by E. Cipollini and W. Gordy. [1962] [5]p. incl. diagrs. (AFOSR-3934) (AF 49(638)765) Unclassified

Also published in Jour. Chem. Phys., v. 37: 13-17, July 1, 1962.

Free radicals produced by γ-irradiation of single crystals of N-acetyl methionine have been investigated through their electron spin resonance patterns for different orientations in the magnetic field. Two chemically different free radicals have been found, both relatively stable at room temperature. One of them has an ESR pattern very similar to that of cystine dihydrochloride. The g tensor for this radical is anisotropic with principal values 2.004, 2.029, and 2.064. An isotropic doublet hyperfine structure of 9.5-gauss spacing is observed. The second resonance has a complex, incompletely resolved, hyperfine structure with a total spread of about 26 gauss. Its almost isotropic g tensor with principal values from 2.002 to 2.005 indicates that the electron spin density is concentrated on a carbon. Structures for both free radicals are proposed. (Contractor's abstract)

822

Duke U. [Microwave Lab.] Durham, N. C.

DOUBLE QUANTUM TRANSITION IN ELECTRON SPIN

RESONANCE OF GAMMA-IRRADIATED ACETYL-D, L-ALANINE, by M. Katayama. [1962] [10]p. incl. diagrs. (Bound with its AFOSR-2310) (AF 49(638)765)
Unclassified

Also published in Phys. Rev., v. 126: 1440-1442, May 15, 1962.

Double quantum transitions were observed at high rf fields in hyperfine spectra of electron spin resonance of the free radical produced by the γ-irradiation of acetyl-d, l-alanine. The presence of interaction between the free radicals gives rise to the double quantum transitions. A theoretical explanation is given. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED SINGLE CRYSTALS OF ACETYL-D, L-ALANINE AND CHLOROACETYL-D, L-ALANINE, by M. Katayama. [1962] [7]p. incl. diagrs. tables, refs. [AF 49(638)765] Unclassified

Published in Jour. Molec. Spectros., v. 9: 429-435, Dec. 1962.

The electron spin resonance spectra of γ-irradiated single crystals of acetyl-d, l- alanine and chloroacetyl-d, l-alanine have been measured at 9 kmc/sec and 23.4 kmc/sec for various orientations in the external magnetic field. The free radical produced by γ irradiation in both compounds is determined to be RCONHC(Me)(CO_2^H) from the analysis of the hyperfine interaction constants. The electron spin densities are approx 0.76 and 0.86 for acetyl-d, l-alanine and chloroacetyl-d, l-alanine, respectively. (Contractor's abstract)

824

Duke U. [Microwave Lab.] Durham, N. C.

ISOTOPIC EFFECT ON THE RELEASE OF ATOMS BY IRRADIATION OF MOLECULES AT LOW TEMPERATURE (Abstract), by W. [V.] Bouldin and W. Gordy. [1962] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 271-272, Apr. 23, 1962.

This work was suggested by an earlier experiment in this laboratory which indicated that H is much more easily removed by γ irradiation of mixed isotopic species of ice at 4.2°K than is D. Partially deuterated methanes have been γ-irradiated at 4.2°K, both pure and in argon and krypton matrices, and it has been found in each instance that the release of an H atom from a CH bond is 4 to 8 times more probable than the release of a D atom from a corresponding CD bond. The relative abundance of H to D was measured by a comparison of the relative strength of the ESR signals of H and D. Some effect of mass on the probability of escape would be expected to result from the appreciable difference in zero-point and from excited vibrational energies which would favor the barrier-tunneling ability of the lighter isotope. Theoretical prediction of the expected differences would be difficult and would seemingly require more knowledge than is available of the barriers to escape from the parent molecule in the different matrices. Nevertheless, use can be made of the H/D production ratios to compare the barriers in different matrices.

825

Duke U. [Microwave Lab.] Durham, N. C.

MILLIMETER WAVE SPECTRA OF HNCS AND HNCO (Abstract), by R. Kewley, K. V. L. N. Sastry, and M. Winnewisser. [1962] [1]p. [AF 49(638)765]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 272, Apr. 23, 1962.

The millimeter wave spectra of isothiocyanic (HNCS) and of isocyanic acid (HNCO) have been studied. Both molecules are slightly asymmetric rotors and were expected to have centrifugal distortion K patterns which would fit the normal centrifugal-distortion expression for a symmetric rotor, if corrections for small asymmetry are taken into account. However, it is found that, whereas the HNCO spectrum fits very closely with the symmetric-rotor expression with normal positive values of D_J and D_{JK}, the K patterns for HNCS and DNCS have an irregular arrangement. The lines K = 0, 1, 2 for the J = 10 - 9, 9 - 8, and 8 - 7 transitions of HNCS and DNCS have been identified. The center frequencies both of the K = 1 components and also of the K = 2 components are displaced towards higher frequencies relative to K = 0, and also do not fit the centrifugal-distortion formula for a symmetric rotor. The possibility of Coriolis interactions due to high rotational energy around the molecular α axis is being investigated. Values of rotational constants are: HNCS: B_0 = 5883.40 mc/sec, C_0 = 5845.62 mc/sec, A_0 = 1,620,000 mc/sec. DNCS: B_0 = 5500.52 mc/sec, C_0 = 5445.01 mc/sec, A_0 = 661,300 mc/sec. HNCO: B_0 = 11070.97 mc/sec, C_0 = 10910.76 mc/sec.

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED SINGLE CRYSTAL OF ACETYL-L-GLUTAMIC ACID, by M. Katayama. [1962] [4]p. incl. diagrs. (AFOSR-J134) (AF AFOSR-62-327) AD 400396
Unclassified

Also published in Jour. Chem. Phys., v. 37: 2143-2146, Nov. 1, 1962.

The electron spin resonance spectra of gamma-irradiated single crystals of acetyl-L-glutamic acid have been measured at 9 and 23.4 kmc/sec for various orientations of the crystal in the external magnetic field. The structure of the free radical produced immediately after the irradiation of acetyl-L-glutamic acid is determined from the analysis of the hyperfine interaction constants. However, this radical transforms to another more stable one in the half-life of 3 days. The structure of the stable free radical is inferred from the hyperfine structure of its electron spin resonance. (Contractor's abstract)

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Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SINGLE CRYSTALS OF D-FRUCTOSE AND L-SORBOSE, by H. Ueda. [1962] [3]p. incl. diagrs. tables. (AFOSR-J784) (AF AFOSR-62-327) AD 413563 Unclassified

Also published in Jour. Phys. Chem., v. 67: 966-968, May 1963.

Among the polycrystalline sugars, only D-fructose and L-sorbose, when irradiated, are known to give an e.s.r. spectrum of 4 lines. When irradiated polycrystalline L-sorbose was heated to 100°, it gave a spectrum identical with that of irradiated D-fructose which had not been heated. In the present work, the results obtained from polycrystalline materials were studied in more detail using single crystals. Irradiation at 77°K followed by heating revealed that a radical transformation occurs in these sugars, which is caused by the deformation of the pyranose ring. The free radical produced is $-CH(OH)-\dot{C}(OH)-CH_2-O-$. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE STUDIES OF RADIATION EFFECTS ON POLYAMINO ACIDS, by R. C. Drew and W. Gordy. [1962] [28]p. incl. diagrs. refs. (AFOSR-J785) (AF AFOSR-62-327) AD 408390 Unclassified

Also published in Radiation Research, v. 18: 552-579, Apr. 1963.

Effects of ionizing radiation on 18 polyamino acids have been examined with the ESR method. In about half of these it was found possible to interpret the ESR observed at room temperature as arising from free radicals formed by loss of the H from the -CHR- group of the polypeptide chain. In the others, the room temperature ESR signals seem to arise from a damaged side chain or R group. The ESR obtained at 77°K are generally different from those obtained in room temperature experiments and may arise often from charged or ionized molecules. Oxygen was found to alter or quench the ESR of all the polyamino acids studied, some more rapidly than others. The elimination of the signal is thought to be caused by a conversion of the radical X to peroxide radicals X-O-O. The later decay of the signal probably results from the release of the H atoms, which escape through the lattice, and the consequent conversion of the polymeric free radicals to stable radicals.

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Duke U. [Microwave Lab.] Durham, N. C.

ON THE L-TYPE DOUBLING AND L-TYPE RESONANCE OF MOLECULES IN THE MICROWAVE REGION, by G. G. Weber. [1962] [27]p. incl. tables, refs. (AFOSR-J797) (AF AFOSR-62-327) AD 413470 Unclassified

Also published in Jour. Molec. Spectros., v. 10: 321-347, May 1963.

The l-type doubling and the l-type resonance of molecules in the microwave region are phenomena which are encountered often but in many cases are not correctly interpreted. The present work has the purpose, to make clear the theory and to apply it to the interpretation of the spectra of: methyl cyanide, methyl acetylene, and tertiary butyl acetylene. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

THE MILLIMETER WAVE SPECTRA OF ISOCYANIC AND ISOTHIOCYANIC ACIDS, by R. Kewley, K. V. L. N. Sastry, and M. Winnewisser. [1962] [24]p. incl. diagrs. tables, refs. (AFOSR-J1298) (AF AFOSR-62-327) AD 424101 Unclassified

Also published in Jour. Molec. Spectros., v. 10: 418-441, June 1963.

An investigation of the mm-wave rotational spectra of the very slightly asymmetric tops HNCS, DNCS, HNCO, and DNCO has been carried out in the frequency range 80,000-190,000 mc/sec. Several R-branch, a-type, transitions were observed for each molecule and the rotational constants A_0, B_0, and C_0 were determined for the 4 species containing the most abundant isotopes of N, C, O, or S. The centrifugal distortion K-patterns is different in character for each of the 4 molecules. Agreement between calculation and experiment is obtained for HNCO and DNCO. This expression gives a poor fit for DNCS and no fit for HNCS, and at present no treatment has been found to fit or explain satisfactorily the K-pattern for these 2 molecules. A number of lines due to rotational transitions of vibrationally excited molecules were also observed and are assigned to the states $v_5 = 1$ and $v_6 = 1$ for HNCS and HNCO and probably, in addition, $v_4 = 1$ for DNCS. (Contractor's abstract, modified)

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Duke U. [Microwave Lab.] Durham, N. C.

A CYCLOTRON RESONANCE STUDY OF IONIZATION IN LOW-PRESSURE FLAMES, by E. M. Bulewicz and P. J. Padley. [1962] [9]p. incl. diagrs. table, refs. (AFOSR-J1296) (AF AFOSR-62-327) AD 424213 Unclassified

Also published in Ninth Symposium (International) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962) New York, Academic Press, 1963, p. 638-646.

Electron concentrations and electron-molecule collision cross sections have been measured by the cyclotron resonance method on flames of hydrocarbons, alcohols, esters, ketones, and ethers, all at reduced pressure. The main observations made in the reaction zone are: (1) The average electron-flame gas molecule collision cross section varies little from fuel to fuel; (2) The electron concentration in hydrocarbon flames is proportional to the total pressure; (3) A plot of the ratio of the electron concentration per molecule of fuel to the total burned flame gas concentration against the number of carbon atoms in the molecule shows the following regularities: points for saturated hydrocarbons lie on a smooth curve; those for unsaturated hydrocarbons lie on various smooth curves displaced upwards to greater ionization levels; if the fuel contains one oxygen atom the ionization is lowered by an approximately constant amount with respect to the corresponding saturated hydrocarbon; when 2 oxygen atoms are present the effect is doubled; and (4) The effect of inert additives such as argon, and of nonhydrocarbon fuel additives such as hydrogen was studied. Results suggest that a very important step in the process of ion production is the reaction $CH + O \rightarrow CHO^+ + e^-$. Polymerization reactions as a means of ion production appear to be of secondary importance. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

A STUDY OF IONIZATION IN CYANOGEN FLAMES AT REDUCED PRESSURES BY THE CYCLOTRON RESONANCE METHOD, by E. M. Bulewicz and P. J. Padley. [1962] [12]p. incl. diagrs. table, refs. (AFOSR-J1300) (AF AFOSR-62-327) AD 424224 Unclassified

Also published in Ninth Symposium (International) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962) New York, Academic Press, 1963, p. 647-658.

The ionization in the reaction zone of cyanogen-oxygen flames at reduced pressure was studied by the method of cyclotron resonance. Although the temperatures of these flames are sufficiently high for thermal ionization of nitric oxide to account for the observed free electron concentrations, other characteristics of the ionization are consistent only with the operation of nonthermal processes. These processes, however, appear to be different from those inferred to be taking place in hydro-carbon-oxygen flames, and seem to involve energetic 3-body reactions. Some auxiliary spectral evidence is also presented. When traces of hydrogen are added, the electron concentration decreases considerably — particularly for fuel-lean flames. As the concentration of cyanogen in the fuel is reduced to about 20%, a second ionization maximum appears, associated with a greenish glow from the burned gases. It is shown that attempts to explain this effect simply in terms of reactions occurring in hydrocarbon-oxygen flames meet with difficulties which cannot be resolved at this stage. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

STARK EFFECT AND DIPOLE MOMENT OF METHYL FLUORIDE, by D. M. Larkin and W. Gordy. [1962] [5]p. incl. illus. diagr. tables. (AFOSR-J1301) (AF AFOSR-62-327) AD 424225 Unclassified

Also published in Jour. Chem. Phys., v. 38: 2329-2333, May 15, 1963.

High-precision Stark effect measurements have been made on the $J = 1 \rightarrow 2$ transition of methyl fluoride in the shorter millimeter wave region. A parallel-plate Stark cell employing silver-coated glass plates held apart by optically ground quartz spacers was used. Millimeter wave power was fed between the plates by 2 sets of horns, one of which allowed for measurement of the $\Delta M = 0$ transitions and the other for measurement of the $\Delta M = \pm 1$ transitions. The dc voltage across the Stark plates was measured with a standard potentiometer. Both the first- and second-order effects were measured. The resulting value for the dipole moment of CH_3F is $\mu = 1.8555 \pm 0.0015$ D for the ground vibrational state. (Contractor's abstract)

834

Duke U. [Microwave Lab.] Durham, N. C.

FLUORINE HYPERFINE INTERACTION IN THE ESR OF IRRADIATED ORGANIC SINGLE CRYSTALS, by R. Lontz and W. Gordy. [1962] [10]p. incl. diagrs. table. (AFOSR-64-0049) (AF AFOSR-62-327) AD 431145 Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 705-804, 1963.

Analysis of the F^{19} hyperfine structure of the free radical produced by γ-irradiation of CF_3CONH_2 indicates that this radical, except for the H atoms, is planar. Although the structure of the crystal is unknown, the planes of the radicals are found to have 2 orientations 68° apart, both parallel to crystal faces. The F^{19} couplings of the 2 F atoms are equivalent and are anisotropic, with principal values of $A_1 = A_2 = 24$ and $A_3 = 178$ gauss. Its axial symmetry indicates that the

coupling arises primarily from electron spin density in an F orbital which has an axis of symmetry perpendicular to the plane of the radical. $CF_3CF_2CONH_2$ was also γ-irradiated. The F^{19} coupling of the CF group is similar to that found in the CF_2CONH_2 radical, but the coupling in the CF_3 group is different and arises partly through hyperconjugation interaction with the σ bonds and partly through π bonding to the F atoms. Surprisingly, at room temperature the F's of the CF_3 group have equivalent coupling, which seems to indicate that the CF_3 group is rotating. The ESR of the irradiated $CF_3CF_2CONH_2$ decays rapidly in air, whereas that of irradiated CF_3CONH_2 does not. (Contractor's abstract, modified)

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Eastern Nazarene Coll. Dept. of Chemistry, Quincy, Mass.

DEUTERIUM EXCHANGE BETWEEN DEUTERIODIBORANE AND ALUMINUM BOROHYDRIDE, by P. C. Maybury and J. C. Larrabee. Oct. 1962 [6]p. incl. diagrs. tables. refs. (AFOSR-J1524) (AF 18(603)119) AD 427510 Unclassified

Also published in Inorg. Chem v. 2: 885-890, Oct. 1963.

The kinetics of the exchange of deuterium between diborane and aluminum borohydride were studied over a temperature range of -7 to 20°, and the orders of reaction were found to be dependent on the relative proportions of B_2D_6 and $Al(BH_4)_3$. When the pressure of B_2D_6 is less than 4 times the $Al(BH_4)_3$ pressure, the reaction order was found to be 0.52 with respect to $Al(BH_4)_3$ and 1.2 with respect to B_2D_6. At ratios greater than 4 the order of reaction with respect to $Al(BH_4)_3$ changed to 0.8 and the order with respect to B_2D_6 changed to -1.2. The activation energy was found to be 14 ± 1 kcal/mol. A mechanism is proposed involving the thermal dissociation of both $Al(BH_4)_3$ and B_2D_6 followed by a rate-determining collision of B_2D_6 with borane radicals. The changing orders of reaction are consistent with a derived steady-state expression for this exchange. Direct experimental evidence was obtained to prove that the boron atoms are undergoing exchange in this reaction by the use of boron-10 enriched B_2D_6. (Contractor's abstract)

836

Edinburgh U. Dept. of Pharmacology (Gt. Brit.).

THE EFFECTS OF STILBESTROL AND PROGESTERONE, AND OF RENAL DENERVATION ON THE RESPONSE OF THE KIDNEYS TO VASOPRESSIN AND OXYTOCIN, by R. P. Deis, S. Lloyd, and M. Pickford. [1962] [10]p. incl. diagrs. refs. [AF 61(052)277] Unclassified

Published in Jour. Physiol. (London), v. 165: 348-357, Feb. 1963.

Dogs were given daily subcutaneous injections of stilbestrol or progesterone, or both together, and the effect of these substances on the renal responses to vasopressin and oxytocin examined. Stilbestrol and progesterone did not significantly affect the antidiuretic effect of either vasopressin or oxytocin. Stilbestrol depressed the rise in electrolyte excretion normally seen on giving vasopressin. After administration of stilbestrol intravenous oxytocin sometimes led to a small immediate increase in Na and Cl excretion, but the normal delayed increase was absent or markedly depressed. The delayed rise was present if oxytocin was given in smaller doses into the carotid artery. Progesterone did not affect the renal response to either vasopressin or oxytocin. When both stilbestrol and progesterone were given, the effects were like those seen when stilbestrol alone was given. It is suggested that stilbestrol affects Na retention by an action on the tissues more than on the kidney, and that its power to change the response to vasopressin and oxytocin may be related to an increased sensitivity of the renal vessels to the constrictor properties of vasopressin and oxytocin. Renal denervation of itself seemed not to affect the responses to oxytocin and vasopressin; the temporary changes noted may have been non-specific and due to surgical interference.

837

Edinburgh U. [Dept. of Pharmacology] (Gt. Brit.).

VASCULAR RESPONSES OF THE RAT TO BRADYKININ, by S. Lloyd. [1962] [5]p. incl. illus. (AFOSR-J175) (AF EOAR-62-79) AD 400427 Unclassified

Also published in Brit. Jour. Pharmacol. and Chemotherapy, v. 19: 503-507, Dec. 1962.

The effects of oestrogens and of sympathetic blockade on the vascular response of rats to bradykinin were studied. No difference in response was found between males and oestrous or dioestrous females. The previous administration of an oestrogen did not affect the response. An augmentation of the depressor response to bradykinin was seen in both sexes after the intravenous administration of either dihydroergotamine or hexamethonium, but not after atropine. Pithing reduced the response to bradykinin. The differences between these results and those previously obtained with oxytocin are discussed. (Contractor's abstract)

838

Edinburgh U. [Dept. of Pharmacology] (Gt. Brit.).

THE EFFECT OF OXYTOCIN ON HAND BLOOD FLOW IN MAN FOLLOWING TOTAL AND SYMPATHETIC NERVE BLOCK, by R. P. Deis, A. H. Kitchin, and M. Pickford. [1962] [7]p. incl. diagrs. (AFOSR-J941) (AF EOAR-62-79) AD 415878 Unclassified

Also published in Jour. Physiol. (London), v. 166: 489-495, 1963.

Measurements made by venous occlusion plethysmography confirmed previous observations that intravenous or intra-arterial oxytocin caused an increase in blood flow in normal hands of both men and women. Following acute denervation due to infiltration of lignocaine around the nerves of one arm, intravascular oxytocin caused a decrease in blood flow on the side of the block, and the normal increase on the unblocked side. After sympathetic block produced by infusion of bretylium tosylate into the brachial artery of one arm, oxytocin decreased hand blood flow on that side, or had no effect on the flow, or in one case, considerably reduced the increase in flow seen before bretylium. Arguments are

put forward showing that the reduction in hand blood after total or sympathetic nerve block must be due to a direct vasoconstrictor effect of oxytocin. These results are similar to those previously noted in rats and dogs.

839

Electron Microscope Soc. of America, Philadelphia, Pa.

ELECTRON MICROSCOPY; FIFTH INTERNATIONAL CONGRESS, VOLUMES I AND II, Philadelphia, Pa. Aug. 29-Sept. 5, 1962, ed. by S. S. Breese, Jr. New York, Academic Press, 1962, 2v. incl. illus. diagrs. tables, refs. (AFOSR-3384) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-74, Atomic Energy Commission, National Institutes of Health, National Science Foundation, and Office of Naval Research) AD 622612; AD 622603
Unclassified

The purpose of this conference is to promote the dissemination of knowledge among electron microscopists on an international scale. Various applications of the electron microscope to biological and non-biological areas are presented.

840

Electronic Communications, Inc., Santa Barbara, Calif.

THE DYNAMICS OF SPINNING BODIES AT LARGE ANGLE OF ATTACK, by J. E. Brunk, W. L. Davidson, and R. W. Rakestraw. Jan. 1962 [152]p. incl. diagrs. tables, refs. (AFOSR/DRA-62-3) (AFOSR-2786) (AF 29(600)2936) Unclassified

A theoretical study was conducted to determine the motion of nonstabilized rolling and spinning bodies at very large angles of attack. From numerical integration of the non-linear six-degrees-of-freedom equations of motion it was found that a rolling cone-cylinder body could achieve a self sustained spinning motion for large ranges of both center-of-gravity position and Reynolds number. The stability of the autorotative motion was investigated using linear theory. For configurations representative of current small missiles descent, velocities as low as approx 100 ft/sec were achieved with spinning motion. Stable spins could be initiated from small angle of attack either by supplying a pitch impulse or effecting aerodynamic destabilization. (Contractor's abstract)

841

Erlangen U. (Germany).

THEORY OF FUNCTIONS OF SEVERAL COMPLEX VARIABLES, by R. Remmert. June 28, 1962 [2]p. (AFOSR-3322) (AF EOAR-61-50)
Unclassified

The first chapter of the planned joint book with H. Grauert on complex analysis was prepared in its first version. It contains theorems of fundamental sheaves, theory of normalization, and Stein's theory. In addition, 5 theorems concerning complex variables are put forth. (Contractor's abstract, modified)

842

Erlangen U. (Germany).

[ON COMPACT HOMOGENEOUS KAHLERIAN MANIFOLDS] Über kompakte homogene Kählersche Mannigfaltigkeiten, by A. Borel and R. Remmert. [1961] [11]p. incl. refs. (AFOSR-3833) (AF EOAR-61-50)
Unclassified

Also published in Math. Ann., v. 145: 429-439, 1962.

Let V be a connected and compact complex manifold such that the group of all holomorphic transformations of V is transitive. The following 3 theorems are established: (1) V is a holomorphic fiber bundle over its Albanes torus; (2) V is a holomorphic bundle over a projective-rational homogeneous manifold with a complex parallelisable manifold in the fiber; and (3) If V admits a Kähler metric, then V is the direct product of a complex torus and a projective-rational manifold. (Math. Rev. abstract)

843

Erlangen U. (Germany).

[ON MODIFICATIONS OF EXCEPTIONAL ANALYTICAL SETS] Über Modifikationen und exzeptionelle analytische Mengen, by H. Grauert. [1961] [38]p. incl. refs. (AFOSR-3837) (AF EOAR-61-50) Unclassified

Also published in Math. Ann., v. 146: 331-369, 1962.

Let X be a complex space and A ⊂ X be a compact analytic subset. The set A is called exceptional if there exists a modification Y of X such that the set A shrinks down to a point y, i.e., X - A = Y - y. The main theme of this paper is the characterization of the exceptional analytic sets and their applications to the theory of manifolds. In Section I, there are given some preparatory notions such as plurisubharmonic functions, pseudo-convexity, and holomorph-convexity for complex spaces. In Section II, Remmert's reduction theorem and its sharpened form by H. Cartan are given. Using these results, a criterion of the exceptional analytic set is given. In Section III, other criteria are given using the coherent analytic sheaf m whose zero-set coincides with the analytic set A. In the final section, the main topic is the complex structure of the neighborhood of an exceptional analytic subset A, especially when X is a complex manifold and A is an analytic subset of codimension 1 without singularity. (Math. Rev. abstract, modified)

844

Erlangen U. (Germany).

[ON COMPACT HOMOGENEOUS COMPLEX

MANIFOLDS] Über kompakte homogene komplexe Mannigfaltigkeiten, by H. Grauert and R. Remmert. [1962] [10]p. incl. refs. (AFOSR-4571) (AF EOAR-61-50) AD 455645 Unclassified

Also published in Arch. Math., v. 13: 498-507, 1962.

For a complex analytic manifold V which is connected, the transcendence degree of the field of meromorphic functions is called the algebraic dimension of V. Then the main result is stated as follows: A connected compact homogeneous complex manifold is a projective (algebraic) variety if its complex dimension coincides with the algebraic dimension. The above theorem is actually proved in a generalized form. Furthermore, the authors discuss the structure of a connected, homogeneous complex manifold V as a fiber variety over a homogeneous projective variety W such that dim W = algebraic dimension of V. The main result above is a generalization of the compact case of a theorem of Chow which asserts that a homogeneous abstract algebraic variety can be imbedded in a projective space. (Math. Rev. abstract)

845

Erlangen U. (Germany).

[A NOTE ON PSEUDOCONVEX MANIFOLDS] Bemerkenswerte pseudokonvexe Mannigfaltigkeiten, by H. Grauert. [1962] [15]p. (AFOSR-64-1629) (AF EOAR-61-50) AD 446887 Unclassified

Also published in Math. Zeitschr., v. 81: 377-391, 1963.

The author proves by an example, that the introduction of a generalization of the notion of complex space is necessary if one wants to develop a general theory of the hull of holomorphy. The generalizations are called complex schemes; in general they are not locally compact and correspondingly the local structure rings are non noetherian.

846

Erlangen U. (Germany).

[THE SIGNIFICANCE OF LEVI'S PROBLEMS FOR THE ANALYTIC AND ALGEBRAIC GEOMETRY] Die Bedeutung des Livischen Problems für die analytische und algebraische Geometrie, by H. Grauert. [1962] [16]p. incl. refs. (AFOSR-64-0670) (AF EOAR-62-40) AD 438668 Unclassified

Also published in Proc. Internat'l. Cong. of Mathematicians, Stockholm (Sweden) (Aug. 15-22, 1962), Djursholm, Institut Mittag-Leffler, 1963, p. 86-101.

An account of the history of the Levi problem and of its significance for analytic and algebraic geometry is given. (Math. Rev. abstract)

847

Erlangen U. (Germany).

[APPROXIMATION OF ANALYTIC SECTIONS IN FIBER BUNDLES WITH HOMOGENEOUS FIBER] Approximation von holomorphen Schnittflächen in Faserbündeln mit homogener Faser, by H. Grauert and H. Kerner. [1962] [6]p. (AFOSR-64-1630) (AF EOAR-62-40) AD 446875 Unclassified

Also published in Arch. Math., v. 14: 328-333, 1963.

The following theorem is proved: Let $X' \subset$ be a Runge pair, let F be a complex-analytic fiber bundle over X with homogeneous fiber, let s' be an analytic section in F over X'. Then s' can be approximated by holomorphic sections in F over X if and only if s' can be approximated by continuous cross-sections.

848

Erlangen U. (Germany).

[CONTRIBUTIONS TO THE THEORY OF HOLOMORPHIC FUNCTIONS ON HOMOGENEOUS COMPLEX MANIFOLDS] Zur Funktionentheorie homogener komplexer Mannigfaltigkeiten, by R. Remmert and A. van de Ven. [1962] [21]p. incl. refs. (AFOSR-64-1831) (AF EOAR-62-40) AD 446873 Unclassified

Also published in Topology, v. 2: 137-157, 1963.

The following theorems are proved. Each connected compact holomorphic map ζ: G/J → Y of a homogeneous complex manifold G/J onto a complex space Y is canonically equivalent to a holomorphic fibration G/J → G/H, where H denotes the isotropy group of a ζ-fiber in G; and Let X be a homogeneous compact algebraic manifold with second Betti number 1 (e.g. a grassmannian), let $G \subset X$ be a domain and $K \subset G$ an algebraic curve. Then each function which is holomorphic in G is constant.

849

Federation of American Societies for Experimental Biology, Washington, D. C.

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON TEMPERATURE ACCLIMATION, Leiden (Holland) (Sept. 5-7, 1962), ed. by R. E. Smith. [1962] [274]p. incl. illus. diagrs. tables, refs. (AFOSR-5113) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-89, Army Medical Research and Development Command, Army Research Office (Durham), National Research Council of Canada, Netherlands Sales Organization of British Petroleum Co., Limited, Office of Naval Research, and Public Health Service) Unclassified

Also published in Fed. Proc., v. 22: 687-960, May 1963.

A comprehensive treatment of temperature acclimation is presented. Topics covered include: acclimatization to heat in man and animals; metabolic and endocrine aspects of acclimatization; neurohumoral responses to cold; effects of chronic cold exposure on organ function; influence of age, sex, and race on temperature acclimatization; climatic adaptation of the newborn; temperature regulatory patterns in man; intermediary metabolism and electron transport; tolerance time and performance in heated environment; peripheral circulation in heat; water and electrolyte metabolism in the heat; thermoceptors; catecholamines in cold adaptation; and habituation and peripheral tissue adaptations.

850

Florida State U. Dept. of Chemistry, Tallahassee.

FUNDAMENTAL ASPECTS OF PHOTOSENSITIZATION. INTERCOMBINATIONS IN MOLECULES, by M. Kasha. Oct. 1956, 3p. incl. refs. (AFOSR-268) (AF 18(600)-678) Unclassified

A list is given of completed works, articles in preparation, and researches in progress. Some of the topics studied are: theory and spectra of simple inorganic ion molecules, study of excitation functions in luminescence, and intercombinations in pyrrols, thiophene and selenophene.

851

Florida State U. Dept. of Chemistry, Tallahassee.

ASSOCIATION CONSTANTS AND NMR ASSOCIATION SHIFTS FOR SEVERAL CHLOROFORM-BASE HYDROGEN-BONDED COMPLEXES, by B. B. Howard, C. F. Jumper, and M. T. Emerson. [1962] [14]p. incl. diagr. tables, refs. (AFOSR-J1378) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)278, Atomic Energy Commission, and Research Corp.) AD 429774 Unclassified

Also published in Jour. Molec. Spectros., v. 10: 117-130, Feb. 1963.

The chemical shifts of chloroform in solutions with several hydrogen bonding bases in either cyclohexane or carbon tetrachloride as solvent were measured at 25° with a precision of ±0.002 ppm. Chloroform-base association constants and association shifts were calculated. Corrections were applied for the effects of dispersion interaction and self- and solvent association. Listing the base, association constant, and association shift in ppm to low field in that order, the resulting values are: triethylamine, 4.70, 1.472; diethyl ether, 3.76, 0.905; diethyl ether, 1.46, 1.266; isopropyl ether, 2.08, 1.126; acetonitrile, 1.14, 0.973; acetone, 2.07, 1.419; and pyridine, 1.90, 2.271. The first 2 are in cyclohexane, the rest in CCl_4. The difference between the association constants of diethyl ether in the 2 solvents is noted as being anomalously large. The effect of the anisotropy of the base can readily be seen in the association shifts of the pyridine and acetonitrile complexes. (Contractor's abstract)

852

Florida State U. Dept. of Chemistry, Tallahassee.

NUCLEAR MAGNETIC RESONANCE STUDY OF ION-EXCHANGE RESINS. I. HYDRATED DOWEX-50 RESINS, by R. H. Dinius, M. T. Emerson and G. R. Choppin. [1962] [5]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)278, Atomic Energy Commission, and Office of Naval Research) Unclassified

Published in Jour. Phys. Chem., v. 67: 1178-1182, June 1963.

The proton magnetic resonance spectra for hydrated ion-exchange resin samples have been measured. The effect on the chemical shift and line width was observed as a function of resin phase hydration, resin cross linkage, and temperature for Dowex-50. The effects are interpreted in terms of changes in water structure and rapid proton exchange in the resin phase. (Contractor's abstract)

853

Florida State U. Dept. of Chemistry, Tallahassee.

ENERGY TRANSFER MECHANISMS AND THE MOLECULAR EXCITON MODEL FOR MOLECULAR AGGREGATES, by M. Kasha. [1962] [16]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)712] and Atomic Energy Commission) Unclassified

Presented at Tenth Annual meeting of the Radiation Research Soc., Colorado Springs, May 20-23, 1962.

Published in Radiation Research, v. 20: 55-70, Sept. 1963.

This paper is devoted to the laying down of a further perspective for the discrimination and understanding of the main types of excitation energy transfer. A necessary introduction to such a discussion will be the

examination of detailed differences in types of intermolecular electronic interaction. The present treatment will be a strictly nonmathematical one. The 5 sections that will be discussed are: the molecular exciton model, comparison of energy transfer mechanisms, vibrational-electronic coupling cases, exciton band structure for strong coupling, and the rates of energy transfer for various mechanisms. Much emphasis is placed on the need for new discriminative experimental work.

854

[Florida State U. Dept. of Mathematics, Tallahassee]

[RESEARCH IN NUMERICAL ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS], by E. P. Miles. Final technical rept. Sept. 1, 1960-Aug. 31, 1961. [Apr. 1962] [6]p. (AFOSR-2617) (AF AFOSR-61-12A) AD 288992 Unclassified

Research on numerical analysis and the study of polynomial solutions for partial differential equations is reviewed. The first phase of the research was largely concerned with improved matrix inversion programs for ill-conditioned matrices. The second phase of computer oriented studies was concerned with approximate solutions of boundary value problems in partial differential equations built up as linear combinations of elements from basic sets of solutions for the equations developed by the principal investigator and E. Williams. The IBM 650 and 709 computers were used in the investigations.

855

Florida State U. [Dept. of Mathematics] Tallahassee.

BASIC SEQUENCES AND THE PALEY-WIENER CRITERION, by J. R. Retherford. [1962] [19]p. incl. refs. (AF AFOSR-62-27) Unclassified

Also published in Pacific Jour. Math., v. 14: 1019-1027, Fall, 1964.

The paper under review is devoted to generalizing the Paley-Wiener type and similar stability criteria for bases and basic sequences in Hilbert and Banach spaces to the case of bases and basic sequences of subspaces. A typical result is the following theorem: Suppose $\{M_i\}_{i=1}^{\infty}$ and $\{N_i\}_{i=1}^{\infty}$ are sequences of nontrivial subspaces of a linear complete metric space X and suppose that T_i is a one-to-one linear transformation of M_i onto N_i $(i = 1, 2, \ldots)$. Suppose further that there is a C $(0 < C < 1)$ such that

$$\left\| \sum_{i=1}^{n} (x_i - T_i x_i) \right\| \le C\left(\left\| \sum_{i=1}^{n} x_i \right\| + \left\| \sum_{i=1}^{n} T_i x_i \right\| \right)$$

for arbitrary x_i in M_i $(i = 1, 2, \ldots, n; n = 1, 2, \ldots)$. Then (a) there is a linear homeomorphism T of $[M_i]$ onto $[N_i]$ such that T restricted to M_i equals T_i for each i; (b) $\{M_i\}_{i=1}^{\infty}$ is an [unconditional] basic sequence of subspaces if and only if $\{N_i\}_{i=1}^{\infty}$ is an [unconditional] basic sequence of subspaces. The case of basic sequences in Banach spaces is considered separately, and a new modification of the Paley-Wiener criterion is given. (Math. Rev. abstract, modified)

856

Florida State U. [Dept. of Mathematics] Tallahassee.

GENERALIZED SCHAUDER BASES, by C. W. McArthur. [1962] 25p. incl. refs. (AF AFOSR-62-27) Unclassified

Presented at meeting of the Amer. Phys. Soc., Tallahassee, Fla., Nov. 16-17, 1962.

Let X be a complete metric linear space and $\{M_s\}_{s \in S}$ an infinite family of nontrivial subspaces of X. $\{M_s\}_{s \in S}$ is an unordered basis for X, if corresponding to each $x \in S$ there exists a unique family $\{x_s\}_{s \in S}$ $x_s \in M_s$, such that x is the unordered sum of the series $\sum_{s \in S} x_s$. $\{M_s\}_{s \in \omega}$ is a basis for X, if corresponding to each $x \in X$ there is a unique sequence $\{x_i\}_{i \in \omega}$, $x_i \in M_i$, such that $x = \sum_{i=1}^{\infty} x_i$. In either case letting $E_s(x) = x_s$, a projection of X onto M_s is defined. Theorem: Suppose $\{M_s\}_{s \in S}$ is a basis for X in either of the above senses. Then E_s is continuous for each $s \in S$, if and only if M_s is closed for each $s \in S$. Theorem: Suppose X is a Banach space, (i) An infinite family $\{M_s\}_{s \in S}$ of nontrivial, closed, S-independent subspaces of X is an unordered basis for X, if and only if there exists $M \ge 1$ such that for arbitrary finite $F \subset S$ and arbitrary $x_s \in M_s$ $\left\| \sum_{s \in F'} x_s \right\| \le M \left\| \sum_{s \in F} x_s \right\|$ if $F' \subset F$. (ii) A sequence $\{M_i\}_{i \in \omega}$ of nontrivial, closed, ω-independent subspaces of X is a basis for X, if and only if there exists $M \ge 1$ such that for arbitrary $q \in \omega$ and arbitrary $x_i \in M_i$, $\left\| \sum_{i=1}^{p} x_i \right\| \le M \left\| \sum_{i=1}^{q} x_i \right\|$ if $p \le q$. (Contractor's abstract)

857

Florida State U. [Dept. of Mathematics] Tallahassee.

ON A GENERALIZATION OF THE SCHAUDER BASIS CONCEPT, by B. L. Sanders. 1962, 3p. (AF AFOSR-62-27) Unclassified

It is shown that a Schauder decomposition of a Banach space X induces a Schauder decomposition of a closed subspace of X^*; that this subspace is all of X^* if the decomposition has a property called shrinking; and that the subspaces, in this induced decomposition, form a Schauder decomposition for all of X^* under the weak topology. The final theorem gives necessary and sufficient conditions for a Banach space with a Schauder decomposition to be reflexive. This is a generalization

of a result of R. C. James which he used in showing that a certain Banach space, which is isometrically isomorphic to its second conjugate, is not reflexive. This characterization of reflexive Banach spaces and the theorem on weak decompositions appear to be the main results of this work.

858

Florida State U. Dept. of Physics, Tallahassee.

ANGULAR DISTRIBUTION OF γ RADIATION FOLLOWING DIRECT NUCLEAR REACTION, by M. Nemoto. [1962] [5]p. incl. diagrs. refs. (AFOSR-971) (AF 49-(638)427) Unclassified

Also published in Phys. Rev., v. 127: 1693-1697, Sept. 1, 1962.

The γ-ray angular distributions following the direct reaction $C^{12}(p,p'\gamma_{4.43\,mev})C^{12}$ have been calculated for two cases of single-particle excitation and collective excitation using Glendenning's optical potential and the surface interaction model. In the case of particle excitation, the effective 2-body potential has been assumed to have the form $V_0(|r_p-r_n|)[a_0+a_1\,\sigma(p)\cdot\sigma(n)]$. Comparison with experiments for incident proton energies E_p = 6.69, 8.46, 8.71, and 9.72 mev shows remarkably good fits for $a_1/a_0 = \pm 0.67$. For the case of collective excitation, the agreement has been found to be poor. The planewave Born approximation for the incoming and outgoing waves does not yield satisfactory results for either mechanism. (Contractor's abstract)

859

Florida State U. [Dept. of Physics] Tallahassee.

MULTI-LEVEL AND MULTI-CHANNEL ANALYSIS OF ELASTIC SCATTERING, by G. E. Mitchell. May 1962 [20]p. incl. refs. (Technical rept. no. 4) (AFOSR-2871) (AF 49(638)427) AD 227282 Unclassified

A review is made of the various approximations for the collision matrix that are relevant for elastic scattering analysis. A brief discussion is given on qualitative and semiquantitative techniques. The 1 level, 1 channel, the 2 level, 1 channel; and n level, 1 channel approximations are derived. The 1 level, n channel problem is treated; it is shown that, with the addition of 1 parameter, ordinary phase shift analysis is applicable. The 2 level, 2 channel approximation is derived from 2 different approaches to illustrate the extension to more levels and channels. (Contractor's abstract)

860

Florida State U. Dept. of Physics, Tallahassee.

ON THE POSSIBILITY OF RESONANT TRANSFER PROCESSES IN NUCLEAR REACTIONS, by G. M. Temmer. [1962] [3]p. (AFOSR-3957) (AF 49(638)427) Unclassified

Also published in Phys. Lttrs., v. 1: 10-12, Apr. 1, 1962.

Ziemba and Everhart first established the existence in atomic physics of the resonant transfer of electrons back and forth between helium ions, traversing helium gas, and the atoms of the gas. The author speculates about the possibility of such effects occurring in nuclear reactions. Several examples are suggested which might be tested experimentally.

861

Florida State U. [Dept. of Physics] Tallahassee.

ALLOWED AND SUPERALLOWED DECAY OF Sc^{42} AND INVERSION OF ISOMERIC STATES (Abstract) by J. D. Oberholtzer, J. W. Nelson, and H. S. Plendl. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 286, Apr. 23, 1962.

Formation of an isomeric state in Sc^{42} via $K^{39}(\alpha,n)$ and its positron decay in coincidence with 3 γ-rays of equal intensity was previously reported. Thresholds and half-lives observed for this allowed decay and for the superallowed ground-state decay are: superallowed decay (8.220 ± 0.50 thresh. (mev); 0.064 ± 0.06 $T_{1/2}$(sec); and 5.525 ± 0.050 E_{max} (mev)); allowed decay (8.800 ± 0.020 thresh. (mev); 62 ± 2.5 $T_{1/2}$(sec); and 2.820 ± 0.040 E_{max} (mev)). E_{max} values are computed from our results and from stable mass values and agree with measured values. The results are compared with recent measurements at MIT and elsewhere. Decay schemes and probable-spin assignments for two-particle excitation levels in Sc^{42} and Ca^{42} are presented. The results indicate that the isomeric state has T = 0 and is 526 kev above the T = 1 ground state, i.e., inversion as in Cl^{34}. The observed isomerism and inversion can be accounted for by jj-coupling considerations.

862

Florida State U. [Dept. of Physics] Tallahassee.

(α,n) REACTIONS IN C^{12}, Si^{28}, AND S^{32} AND THE (p,n) REACTION ON Cl^{35} (Abstract), by J. W. Nelson, E. B. Carter and others. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 286, Apr. 23, 1962.

Neutron thresholds for α particles incident on C^{12}, Si^{28}, and S^{32} have been previously reported (item no. 737, Vol. V). These measurements have been extended using improved apparatus. The excitation curve for

$C^{12}(\alpha, n)O^{15}$ has been measured for incident α-particle energies from threshold (11.33 mev) to 19 mev. The outstanding feature of this curve is a resonance at α energy 14.8 mev of half-width 400 kev corresponding to a level at 18.25 mev in O^{16}. The ground-state thresholds for C^{12} and Si^{28} targets are in agreement with values in the 1960 Nuclear Data Tables. In contrast, the $S^{32}(\alpha, n)A^{35}$ threshold (9.864 ± 0.035 mev) is higher than the calculated value by 140 kev. As a check on the A^{35} positron end point, the $Cl^{35}(p, n)A^{35}$ threshold was measured to be 6.942 ± 0.020 mev, which agrees with the end point. The results of half-life determinations for all 3 cases are presented.

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Florida State U. [Dept. of Physics] Tallahassee.

ARE THERE RESONANT TRANSFER PROCESSES IN NUCLEAR REACTIONS? (Abstract), by G. M. Temmer. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 569-570, Nov. 23, 1962.

If a system, consisting of 2 subunits A' and B, is bombarded by a beam of A, the possibility exists of transferring B from A' to A without expenditure of energy (A' = A). The "transfer time" τ is a quantity determined by the binding energy of B to A, and the distance R between A' and A. The presence of A produces a splitting ΔE of the ground state of B in the field of A, which increases with decreasing separation R of systems (A' + B) and A, $h/4\pi\Delta E = \tau$. This is a well-known problem in atomic and molecular physics (e.g., inversion spectrum of NH_3). If the "time of passage" T of A traversing (A' + B) equals $n\tau$, where n = 1, 2, 3, . . . , one, two, three, etc., transfers of B between the 2 equivalent sites A may occur. A most beautiful demonstration of this effect was given by Everhart et al for the systems $He^+ + He^0$ and $H^+ + H^0$ for the transfer of an electron, revealing a relative neutral-atom yield at a fixed scattering angle varying as $\sin^2(k/E^{1/2})$ over a large range of ion energies E (k = const). In view of the successful description of many nuclear states in terms of cluster configurations, we examined a typical case: $Li^6(\alpha + d)$, bombarded by α. Using a naive, 1-dimensional square-well model for Li^6, we estimate $\tau \approx 7 \times 10^{-22}$ sec for R = 2 F. T for a 4-mev α across Li^6 is $\approx 5 \times 10^{-22}$ sec (i.e., $\tau \approx T$), hence there exists the possibility of observing peaks and valleys in the relative yields of the 2 systems, during elastic scattering. Other favorable examples are $p + d$, $He^3 + He^4$, $Li^6 + Li^7$, $O^{16} + N^{15}$, $O^{16} - F^{19}$, $O^{16} + Ne^{20}$, etc. Possible applications to high-energy physics are discussed.

864

Florida State U. [Dept. of Physics] Tallahassee.

$Be^9(p, \alpha)Li^6$: TEST CASE FOR DIRECT REACTION THEORY (Abstract) by R. R. Blieden, G. M. Temmer, and K. L. Warsh. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 570, Nov. 23, 1962.

The monotonic behavior of the total cross section and the remarkably energy-independent angular distributions for α_0 and α_1 in the previously reported reaction $Be^9(p, \alpha_0)Li^6$ imply that it is a direct process. Data was obtained on the elastic scattering in the incident and exit channels which further support this conclusion. The excitation curves for $Be^9(p, p)Be^9$ and $Li^6(\alpha, \alpha)Li^6$ are quite smooth in the region from 10- to 14-mev excitation energy in B^{10}. Angular distributions and excitation curves for these reactions as well as for $Be^9(p, p')Be^{9*}$ (2.43) and $Be^9(p, d_0)Be^8$ are presented. Preliminary fits by G. R. Satchler to the (p, α) data using the SALLY computer code for the distorted-wave theory of direct reactions are encouraging and are presented.

865

Florida State U. [Dept. of Physics] Tallahassee.

$C^{12}(d, p\gamma)$ PROTON-GAMMA ANGULAR CORRELATIONS, by N. R. Fletcher, D. R. Tilley, and R. M. Williamson. [1962] [15]p. incl. diagrs. tables, refs. [AF 49(638)427] Unclassified

Published in Nuclear Phys., v. 38: 18-32, Oct. 1962.

The $C^{12}(d, p\gamma)C^{13}$ angular correlations through the second and third excited states of C^{13} have been measured at reaction angles near the stripping maximum with bombarding energies of 2.80, 3.23, and 3.70 mev. Both correlations have the angular symmetries of direct reactions. The energy dependence of these correlations, which involve negative Q value reactions, is much less than that of positive Q value (d, pγ) reactions measured in this energy region. The p_2-γ angular correlation has been measured in the azimuthal plane and at several different proton angles in the reaction plane to determine the extent of applicability of the distorted wave stripping theory. The stripping character of both the $C^{12}(d, p_2)$ and $C^{12}(d, p_3)$ reactions appears to be modified by compound nucleus formation. Tentative multipole mixtures assigned are $\Gamma(E2)/\Gamma_\gamma \lesssim 5\%$ for the 3.68 mev radiation and $\Gamma(E3)/\Gamma_\gamma \lesssim 2\%$ for the 3.85 mev radiation.

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Florida State U. [Dept. of Physics] Tallahassee.

$Cl^{35}(\alpha, n)K^{38}$ REACTION THRESHOLDS (Abstract), by J. W. Nelson, A. L. Elattar and others. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 571, Nov. 23, 1962.

Thresholds for the formation via $Cl^{35}(\alpha, n)$ of the lowest T = 0 and T = 1 states in K^{38} were determined by observing the onset of the superallowed and allowed β^+ activities following bombardment of AgCl with α's (6.0-7.5 mev) from the FSU tandem Van de Graaff accelerator. Maximum β^+ energies computed from these results and stable mass values compare with previous determinations as follows:

Activity	Threshold (mev)
allowed (T = 0)	6.610 ± 0.035
superallowed (T = 1)	6.828 ± 0.035

E_{max} (mev) from threshold	E_{max} (mev) prev. det.
2.815 ± 0.045	2.68 ± 0.03
5.170 ± 0.035	4.57 ± 0.13 or 5.06 ± 0.11

The previously inferred sequence of the lowest T = 0 and T = 1 levels in K^{38} is herewith confirmed. The separation of these levels appears to be 196 kev, i.e., larger than previously assumed.

867

Florida State U. [Dept. of Physics] Tallahassee.

DISTORTED WAVE ANALYSIS OF THE (p, α) REACTION ON Be^9 (Abstract), by H. R. Blieden, G. M. Temmer, and K. L. Warsh. [1962] [1]p. [AF 49(638)-427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 434, Aug. 27, 1962.

Using the optical parameters discussed in the following paper (item no. 868) for the elastic scattering in the incident and exit channels of the reaction $Be^9(p, \alpha)Li^6$, a distorted-wave calculation for this reaction is made using the computer program of R. H. Bassel et al. The reaction is assumed to occur via the pickup of a triton by the incident proton. It is found that sets of optical parameters that give equivalent fits to the elastic-scattering data give considerably different results for $Be^9(p, \alpha)Li^6$ when used in the DWBA calculation. The possibility of spin-orbit coupling effects has also been examined with the computer program JULIE. A detailed comparison is made of these calculations with the experimental results reported earlier.

868

Florida State U. [Dept. of Physics] Tallahassee.

ELASTIC AND INELASTIC SCATTERING FROM Li^6 AND Be^9 (Abstract), by G. M. Temmer and H. R. Blieden. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 434, Aug. 27, 1962.

Angular distributions and excitation functions for the elastic scattering of α particles from Li^6 and for the inelastic scattering to the 2.184-mev state of Li^6 have been obtained in the region $10.00 \leq E_\alpha \leq 12.54$ mev. The elastic scattering of protons from Be^9 and the inelastic scattering to the 2.43-mev state of Be^9 have also been studied for $6.00 \leq E_p \leq 8.00$ mev. The elastic scattering in each case has been analyzed in terms of a local optical-model calculation. On the basis of the optical parameters obtained a DWBA calculation is made for each inelastic process. Finally, the combined elastic and inelastic scattering are calculated in the strong-coupling approximation by assuming a quadrupole collective excitation for the inelastic scattering. A comparison of the calculations with the experimental results is presented.

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Florida State U. Dept. of Physics, Tallahassee.

ELASTIC SCATTERING OF ALPHA PARTICLES BY O^{15} FROM 6.0 MEV TO 10.0 MEV (Abstract), by W. E. Hunt, M. K. Mehta, and R. H. Davis. [1962] [2]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 71-72, Jan. 24, 1962.

Excitation curves have been measured at 10 angles in the bombarding energy range 6.0 to 10.0 mev. Below 10 mev only the elastic scattering channel is significant in the bombardment of O^{16} with alpha particles, since the inelastic scattering cross section is negligible. Solid targets have been fabricated by evaporating lithium metal onto thin carbon foils and subsequently forming LiOH by exposure to air. At least 15 resonances have been resolved in the region of Ne^{20} excitation energy 9.53 to 12.73 mev. By obtaining the behavior of the differential cross section at angles corresponding to the zeros of the first 8 Legendre polynomials several

tentative spin and parity assignments can be made. In addition to the excitation curves, angular distributions have been measured in steps of 3 degrees at bombarding energies 8.63 and 9.92 mev. Both detailed angular distributions exhibit diffraction patterns; there is a marked increase in the number of maxima at 9.92 mev over that at 8.63 mev.

870

Florida State U. [Dept. of Physics] Tallahassee.

ELASTIC SCATTERING OF α PARTICLES FROM Al^{27} (Abstract), by M. A. Ijaz, P. W. Weiss, and R. H. Davis. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 532, Nov. 23, 1962.

The differential cross section for elastic scattering of α particles from natural aluminum targets (150 kev thick for 10-mev α-particles) has been measured for incident α-particle energies between 7 and 19 mev at laboratory angles of 81.7°, 118.5°, 135°, and 158°. Throughout this energy region, these excitation curves display many unresolved resonances and some broad structure. Nine angular distributions have been measured in this energy range. The principal feature of these angular distributions has been their moderate backward peaking, the cross section rising to 10 times that of Rutherford scattering at 170° (lab). The shapes of the excitation curves and angular distributions differ markedly from those taken on the neighboring nucleus Si^{28}, which display many strong resonances in the excitation function, and pronounced diffraction patterns in the angular distributions. Preliminary results of an optical-model analysis are presented.

871

Florida State U. [Dept. of Physics] Tallahassee.

ELASTIC SCATTERING OF α PARTICLES FROM Si^{28} (Abstract), by P. B. Weiss, N. R. Fletcher, and R. H. Davis. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 570, Nov. 23, 1962.

Alpha particles have been elastically scattered from self-supporting SiO and Si foils of thickness corresponding approximately to 50 kev for a bombarding energy of 10 mev. The scattered yield was detected and analyzed in solid-state charged-particle counters. Preliminary investigation of the excitation function at several angles in the bombarding energy range of 8-17 mev shows strong anomalies at about 8.8, 7.9, 8.6, 11.8, 12.8, and 13.8 mev. Many overlapping resonances have been observed throughout the range of bombarding energy. Angular distributions have been measured at 1-mev intervals from 8-18 mev inclusive with several additional distributions in the vicinity of strong anomalies. Angular distributions change slowly with bombarding energy except at prominent resonances. Here, the variation is more abrupt; additional structure of marked shifts in its angular location found. Interference effects with strong backward peaking are prominent in all angular distributions.

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Florida State U. [Dept. of Physics] Tallahassee.

EXCITATION CURVE AND ANGULAR DISTRIBUTION OF THE $F^{19}(p,\alpha_0)O^{16}$ REACTIONS (Abstract), by K. L. Warsh, H. R. Blieden, and G. M. Temmer. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 300, Apr. 23, 1962.

Using the proton beam from our Tandem accelerator, we have measured the yield of the reaction $F^{19}(p,\alpha_0)O^{16}$ at θ(laboratory) = 70° from 3.3 to 12.1 mev bombarding energy with junction counters. Large yields in the excitation curve are observed in the vicinity of 5.0 and 7.7 mev with considerable structure over the whole range of excitation. Angular distributions taken at intervals throughout this range show a wide variation of shapes, including large yields at backward angles. The data taken at the higher energies confirmed the measurements of Ogata, while the data at lower energies agree with the results of Teplov et al. Absolute cross sections have been measured by means of a gas target.

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Florida State U. [Dept. of Physics] Tallahassee.

EXCITATION FUNCTION AND ANGULAR DISTRIBUTIONS FOR THE $Li^6(d,\alpha)\alpha$ REACTION (Abstract), by I. G. Han and N. P. Heydenburg. [1962] [1]p. [AF 49-(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 570, Nov. 23, 1962.

The $Li^6(d,\alpha)\alpha$ reaction has been studied for deuteron-bombarding energies between 2 and 12 mev. This corresponds to an excitation region in Be^8 from 23.7 to 31.3 mev, which overlaps and extends the region previously investigated with the $Li^7(p,\alpha)\alpha$ reaction. The targets were of 95% Li^6 evaporated on thin carbon backing material. The α particles were detected with a solid-state counter. The excitation function at 90° (lab)

shows a prominent peak at 3.85 mev corresponding to a level in Be^6 at 25.16 mev. This level was observed as a weak resonance in our previous work on the $Li^7(p,\alpha)\alpha$ reaction. A tentative assignment of $J = 2^+$ has been given to this level by M. Nomoto. Beyond the resonance, the yield diminishes slowly with increasing energy. Angular distributions are shown in the region of the resonance and at the higher energies.

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Florida State U. Dept. of Physics, Tallahassee.

EXCITATION FUNCTION AND ANGULAR DISTRIBUTIONS FOR THE $Li^6(p,He^3)He^4$ REACTION (Abstract), by N. P. Heydenberg and I. G. Han. [1962] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 58, Jan. 24, 1962.

The $Li^6(p,He^3)He^4$ reaction with an enriched target has been studied, using junction counter detection of the He^3 and alpha particles, and proton bombarding energies between 3.0 mev and 12.5 mev with a tandem Van de Graaff accelerator. The excitation function at 70° is a monotonically decreasing function with increasing energy. The angular distributions from 7.0 to 12.0 mev show a strong forward peak and a small backward peak indicating the possible presence of a direct reaction. As the bombarding energy decreases, the broad maximum at about 100° which was observed in the angular distributions at the higher energies disappears at about 6.0 mev, and an additional maximum at about 50° appears at about 7.5 mev.

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Florida State U. Dept. of Physics, Tallahassee.

GAMMA-RAY ANGULAR DISTRIBUTION FOLLOWING DIRECT REACTION IN C^{12} (Abstract), by M. Nomoto. [1962] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 60, Jan. 24, 1962.

The gamma-ray angular distributions following the reaction $C^{12}(p,p\gamma_{4.43}\text{ mev})C^{12}$ were measured for several incident proton energies in the vicinity of 7 and 9 mev where the excitation curve shows no pronounced compound-nucleus resonances. These distributions were analyzed using Glendinning's optical potential in addition to the Coulomb potential assuming a direct process. The analysis was made for the cases of single-particle excitation and collective excitation. In the former case, the theoretical gamma-angular distribution curve for a spin-flip two-body potential and a non-spin-flip potential differ considerably; remarkably good fits to 4 experimental curves were obtained for the same potential with an approximate Rosenfeld mixture, neglecting the exchange integral. For the case of collective excitation, the agreement was found to be poor. The analysis also showed that the plane-wave Born approximation does not yield satisfactory results for either mechanism.

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Florida State U. [Dept. of Physics] Tallahassee.

γ-RAYS FROM THE REACTION $Be^9(\alpha, n_1\gamma_{4.43})C^{12}$ (Abstract), by J. B. Seaborn, G. E. Mitchell and others. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 269, Apr. 23, 1962.

The excitation function for the reaction $Be^9(\alpha,n_1\gamma_{4.43})C^{12}$ has been measured at 0° and 90° (laboratory angle) for α energies from 3.3 to 9.3 mev. The 4.43-mev γ-rays produced in a thin (~0.1 mg/cm^2) beryllium target were detected with 3 in. x 3 in. NaI(Tl) crystals. In addition to the previously reported resonance at 3.99 mev, there is a very broad (~2 mev) resonance or series of resonances at about 5.0 mev. Above this large resonance, the yield decreases nearly monotonically. At 9.5 mev and above, there is a large contribution to the yield from the $C^{12}(\alpha,\alpha_1\gamma_{4.43})C^{12}$ reaction due to carbon contamination; in addition, the high-energy neutrons increasingly obscure the γ spectra. Thirteen angular distributions were measured between 3.3 and 7.6 mev. At 5.25 mev and below, the angular distributions have a maximum near 0°. Above this energy, the maximum yield occurs between 15° and 30°. All angular distributions show minimum values at 90°.

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Florida State U. [Dept. of Physics] Tallahassee.

GIANT RESONANCE IN THE $B^{11}(p,\gamma_1)C^{12}$ REACTION AT 11.7 MEV (Abstract), by J. A. Becker and J. D. Fox. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 570, Nov. 23, 1962.

The yield of γ-rays resulting from proton capture by B^{11} leading to the ground state (γ_0) and first excited state (γ_1) of C^{12} has been studied for proton energies from 6-13.2 mev. The proton beam, held to less than 1 μA to reduce pileup, was focused on the natural boron target and stopped in graphite 3 m from the target. The

γ-rays from the target were collimated to a beam 5 cm in diam and entered a 5-in.-diam by 4-in.-thick NaI(Tl) detector axially. Electronic pileup was reduced by using a biased preamplifier. All measurements were made with the detector at 90° to the incident beam and 30 cm from the target. The yield of γ_0 exhibits 1 strong maximum near 7.2 mev (22.56 mev in C^{12}) and falls off at higher energies. It is found that the yield of γ_1 exhibits maxima at 6.75, 8.4, 10.4, and 11.9 mev; the last probably is the analog to the giant dipole resonance for γ_0.

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Florida State U. [Dept. of Physics] Tallahassee.

MAGNETIC SPECTROGRAPHIC SATURATION EFFECT ON SEVERAL Q_0-VALUES (Abstract), by A. R. Tajera. [1962] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 570, Nov. 23, 1962.

The effects were studied of the main and fringing fields of a spectrograph at high field strengths on a group of high Q_0 values which had large discrepancies when compared with those computed in recent nuclear-mass tables. An experimental correction curve was obtained from well-known lower Q values at unsaturated and saturated fields. The Q_0 values so corrected are: $He^3(d,p)He^4$, $Q_0 = 18.380 \pm 0.010$ mev; $Li^6(d,\alpha)He^4$, $Q_0 = 22.403 \pm 0.012$ mev; $B^{10}(d,\alpha)$-Be^8, $Q = 17.830 \pm 0.006$ mev; and $N^{14}(d,\alpha)C^{12}$, $Q = 13.579 \pm 0.006$ mev. The energy-cycle closure errors were satisfactorily improved for (He, Li) and Be, B) cycles. The (N, C) cycle was well closed with MIT's $N^{15}(d,\alpha)C^{13}$ and $N^{15}(p,\alpha)C^{12}$ Q_0 values. The N^{15} target seems relatively thick.

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Florida State U. [Dept. of Physics] Tallahassee.

PROTON-INDUCED FISSION OF Th^{232} AND U^{238} BELOW 12 MEV (Abstract), by J. R. Meriwether, J. D. Fox, and G. R. Choppin. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)427] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 303, Apr. 23, 1962.

The excitation functions for the fission of U^{238} and Th^{232} by protons of energy between 3 and 12 mev have been measured using a recoil-catching technique. The proton beam was obtained from the Florida State U. Tandem Van de Graaff. The cross section varies from about 0.00015 mb at 3 mev to 120 mb at 12 mev in the case of Th^{232} and from about 0.0007 mb at 3 mev and 140 mb at 12 mev in the case of U^{238}. The peak-to-valley ratios of the kinetic-energy spectrum of the fission fragments have been measured as a function of proton energy using p-n junction counters. A plot of these ratios as a function of proton energy shows a general decrease in the ratio of asymmetric to symmetric fission as the energy is increased with the exception of 3 upward breaks in the curve. In the bombardment of Th^{232}, these breaks occurred at 7.50, 9.25, and 11.25 mev, and in the bombardment of U^{238} they occurred at 6.75, 8.25, and 10.50 mev.

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Florida State U. [Dept. of Physics] Tallahassee.

SURVEY OF THE $N^{15}(p,\alpha)C^{12}$ REACTION UP TO 12.6 MEV (Abstract), by G. Roy, H. S. Adams, and G. M. Temmer. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 570, Nov. 23, 1962.

The excitation functions were measured for the reactions $N^{15}(p,\alpha_0)C^{12}$ and $N^{15}(p,\alpha_1)C^{12*}$ [and (p,α_2) to the O^+ state, at the higher energies] for proton energies between 3.3 and 12.6 mev, using enriched N^{15} gas (97.2%) contained in a gas cell between nickel foils and a junction counter fixed at 90° to the beam to detect the α particles. The region of excitation covered in O^{16} ranges from 15.2 to 24.0 mev. It should be noted that the ground-state transition (as well as the transition to the 7.65-mev state) can only be fed from natural parity states in O^{16}, whereas all types of compound states (except O^-) can contribute to the 4.43-mev (2^+) state transitions. A very pronounced resonant structure was observed up to about 20-mev excitation in O^{16}, after which the excitation curve becomes considerably smoother, although some structure is still present. The absolute differential cross section was obtained at 90° by comparing with elastic photon-helium scattering which is well known at several energies. The cross section ranges from 20 mb/sr at $E_p = 5$ mev to 2 mb/sr at the highest bombarding energy. To the extent that isotopic spin conservation holds, only $T = 0$ compound states should be observable. A detailed comparison of the reaction will be made with the $N^{15}(p,\gamma_0)O^{16}$ inverse photonuclear reaction in which the strongest contributions are expected to be from $I = 1^-$, $T = 1$ dipole states.

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Florida State U. Dept. of Physics, Tallahassee.

SYMMETRY SELECTION RULES FOR TESTING NUCLEAR CLUSTER STRUCTURE: APPLICATION TO Be^8 (Abstract), by G. M. Temmer. [1962] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 59, Jan. 24, 1962.

Recent work on $Li^7(p,\alpha)\alpha$ located two narrow states (width ~1 mev) at 20- and 22-mev excitation in Be^8. Despite their mode of observation, they are clearly not $(\alpha + \alpha)$ states. The ratio of $\Gamma_n \div \Gamma_p \div \Gamma_\alpha = 70 \div 25 \div 1$ indicates that the descriptions $(Be^7 + n)$ are also inappropriate. It is believed that these sharp states in Be^8 are indeed s-state $(Le^6 + d)$ configurations, lying below the actual $Li^6 + d$ threshold.

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Florida State U. Dept. of Physics, Tallahassee.

THRESHOLDS OBSERVED IN THE $C^{12}(\alpha,n)O^{15}$, $Si^{28}(\alpha,n)S^{31}$, $S^{32}(\alpha,n)Ar^{35}$, $S^{34}(\alpha,n)Ar^{37}$, AND $Cl^{35}(p,n)Ar^{35}$ REACTIONS, by J. W. Nelson, E. B. Carter and others. [1962] [5]p. incl. diagrs. refs. [AF 49(638)427] Unclassified

Published in Phys. Rev., v. 129: 1723-1727, Feb. 15, 1963.

The following thresholds have been measured in the (α,n) reaction: C^{12} 11.341 ± 0.015; Si^{28} 9.30 ± 0.05, 10.55 ± 0.05, 11.83 ± 0.05, 12.78 ± 0.05; S^{32} 9.846 ± 0.020, 10.69 ± 0.05, 11.97 ± 0.06; S^{34} 5.17 ± 0.10, 5.96 ± 0.05, 6.90 ± 0.05, 8.04 ± 0.05, 9.09 ± 0.05, 10.09 ± 0.05, 10.31 ± 0.05 mev. These results are in agreement with previously published results except for the $S^{32}(\alpha,n)Ar^{35}$ ground threshold which is 140 kev higher than expected. To confirm the value of the mass Ar^{35}, the $Cl^{35}(p,n)Ar^{35}$ threshold energy was measured and is 6.942 ± 0.020 mev. Since this result agrees with the accepted value of the Ar^{35} mass, the 140-kev discrepancy was not resolved. In the $C^{12}(\alpha,n)O^{15}$ excitation curve a prominent resonance of half-width 220 ± 60 kev was found corresponding to a level in O^{16} of excitation 18.10 ± 0.06 mev. The cross section rises to about 22 mb at the peak of this resonance. Half-life determinations yielded the values: O^{15} 122.6 ± 1.0, S^{31} 2.56 ± 0.10, and Ar^{35} 1.76 ± 0.03 sec.

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Florida State U. [Dept. of Physics] Tallahassee.

YIELD OF THE $Na^{23}(p,\alpha)Ne^{20}$ REACTION (Abstract), by K. L. Warsh, H. R. Blieden, and G. M. Temmer. [1962] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 569, Nov. 23, 1962.

The reaction $Na^{23}(p,\alpha)N^{20}$ has been studied using our tandem and junction counters. The counters were biased so thin as to register pulses proportional to the energy for α's but only small pulses for protons. The targets used were metallic sodium evaporated on carbon backing. The spectrum seen includes the new states in Ne^{20} at 5.80 and 7.02 whose character was determined by the Chalk River group. The yields to the ground state and first-excited state of Ne^{20} have been measured at 90° (lab) from 3.2 to 12.2 mev and 3.8 to 12.2 mev, respectively. The angular distributions for several states of Ne^{20} have been measured at 10.0 mev. The angular distributions show a wide variation of shapes, including large forward and backward peaking.

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Florida State U. Dept. of Physics, Tallahassee.

CAPTURE OF PROTONS BY B^{11} IN THE GIANT RESONANCE REGION, by J. A. Becker and J. D. Fox. [1962] [7]p. incl. diagrs. table. (AFOSR-4153) (AF AFOSR-62-123) AD 418060 Unclassified

Also published in Nuclear Phys., v. 42: 609-675, Apr. 1963.

The yield of γ-rays resulting from proton capture by B^{11} leading to the ground state (γ_0) and first excited state (γ_1) of C^{12} has been studied for proton energies from 6 to 13.2 mev. The proton beam, held to less than 1 μA to reduce pileup, was focussed on the natural boron target and stopped in graphite 3 m from the target. The γ-rays from the target were collimated to a beam 5 cm in diam and entered a 12.7 cm diam by 10.2 cm thick NaI(Tl) detector axially. Electronic pileup was reduced by using a biased preamplifier. All measurements were made with the detector at 90° to the incident beam and 30 cm from the target. The yield of γ_0 exhibits one strong maximum near 7.2 mev (23.56 mev in C^{12}) and decreases steadily at higher energies, except for a small anomaly at 10.4 mev. The yield of γ_1 exhibits maxima at the incident proton energies 6.75, 8.4, 10.4 and 11.9 mev. The experimental results are compared with the predicted T = 1 states of C^{12}. (Contractor's abstract)

885

Florida State U. Dept. of Physics, Tallahassee.

GAMMA RAYS FROM THE $Be^9(\alpha,n)C^{12}$ REACTION, by J. B. Seaborn, G. E. Mitchell and others. [1962] [3]p. incl. diagrs. table, refs. (AFOSR-J961) (AF AFOSR-62-423) AD 418073 Unclassified

Also published in Phys. Rev., v. 129: 2217-2219, Mar. 1, 1963.

The excitation of the 4.43 - mev gamma ray from the $Be^9(\alpha,n_1\gamma_{4.43})C^{12}$ reaction has been studied and angular distributions have been measured at 13 α-particle energies from 3.3 to 7.6 mev in an effort to determine compound nucleus nature of the $Be^9 + \alpha$ system. Many broad resonances are found in the energy region studied. (Contractor's abstract)

886

Florida State U. Dept. of Physics, Tallahassee.

He^-, H_2^-, AND OTHER NEGATIVE ION BEAMS AVAILABLE FROM A DUOPLASMATRON ION SOURCE WITH GAS CHARGE EXCHANGE, by E. B. Carter and R. H. Davis. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-J963) (AF AFOSR-62-423) AD 418222 Unclassified

Also published in Rev. Scient. Instr., v. 34: 93-96, Jan. 1963.

Negative helium-ion beams have been produced in a commercial negative-ion source in which positively charged beams from a duoplasmatron ion source are converted in a gas charge exchange canal. Beams of negative helium ions with currents up to 30 mμA have been injected into a tandem Van de Graaff accelerator, and α-particle beams have been obtained from the accelerator with energies up to 19 mev and currents up to 2½ mμA. The results of several experiments which were performed to determine the source operating characteristics for negative helium ions are presented. In addition to the peak corresponding to the He^- beam, many other peaks are observed in the momentum distribution of the beam from the negative ion source. Confirming evidence has been found for the existence of the H_2^- ion.

887

Florida State U. Dept. of Physics, Tallahassee.

A SCATTERING CHAMBER USING JUNCTION COUNTERS, by E. J. Feldl, J. R. Meriwether and others. [1962] [6]p. incl. illus. diagrs. (AFOSR-64-535) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-423 and Atomic Energy Commission) AD 435920 Unclassified

Also published in Nuclear Instr. and Methods, v. 22: 333-338, Apr. 1963.

The specifications and characteristics of a versatile scattering chamber are presented. The chamber is designed for use with solid state detectors and possesses the following features: (1) precise positioning of the target, (2) precise positioning of counters both with respect to the distance from the target and the angle to the beam, (3) ease of rotation of the counters to different angles, (4) provision for both movable and fixed counters, (5) precision positioning of the chamber about the beam tube, (6) precise defining slits for both the beam and the particles to be counted, (7) freedom from trailing lead wires as the counters are rotated, and (8) a Faraday cup which provided accurate measurements of the beam current. (Contractor's abstract, modified)

888

Florida U., Gainesville.

A NOTE ON AN INEQUALITY OF M. MARCUS AND M. NEWMAN, by H. Minc. [1962] [3]p. (AFOSR-64-0712) (AF AFOSR-62-168) AD 436502 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 890-892, Dec. 1963.

In a recent paper Marcus and Newman proved that if A is a symmetric positive semidefinite doubly stochastic matrix the $p(A) \equiv n!/n^n$ with equality if and only if $A = J_n$, the matrix all of whose entries are $1/n$. In the present note, the result of Marcus and Newman is extended to all positive semidefinite hermitian matrices which have $e = (1, 1, \ldots, 1)$ as a characteristic vector and prove it by a new method.

889

Florida U. Dept. of Physics, Gainesville.

AN EXPERIMENTAL STUDY OF THE INTERACTION OF PLASMONS AND FAST ELECTRONS IN METALS AND A STUDY OF ELECTRON TUNNELING THROUGH THIN INSULATING FILMS, by W. B. Ard, Jr. Final rept. Oct. 15, 1960 - June 14, 1962 [86]p. incl. diagrs. tables, refs. (AFOSR-2937) (AF 49(638)956) AD 282138 Unclassified

The characteristic energy losses observed when a beam of energetic electrons passes through a thin film of metal have been studied by using the retarded potential method of energy analysis. The spectrum for aluminum, magnesium, antimony, tin and indium appears in multiples of an energy which is approximately equal to the free electron plasmon energy while the spectrum of the other metals shows no such regular pattern. The mean free path and cross section for plasmon production have been determined and compared with the Bohm and Pines theory. Good agreement was found for aluminum and magnesium. These quantities, cross sections and mean free paths, were found to be independent of film thickness but did have the predicted dependence on incident electron energy. The second part of this report discusses the energy gaps and the density of electronic states in metal films, from 500 to 5000A thick, that have been obtained from electron tunneling experiments.

The negative resistance region which occurs when both metals are superconducting was observed as a hysteresis loop. The variation of the energy gap and density of states has also been studied, and the experimental results agree closely with the Bardeen, Cooper, Schrieffer theory. (Contractor's abstract, modified)

890

Florida U. [Dept. of Physics] Gainesville.

DETERMINATION OF THE MEAN FREE PATH FOR EXCITATIONS OF PLASMONS IN METALS (Abstract), by H. J. Watson, M. F. Panczyk, and W. B. Ard, Jr. [1962] [1]p. [AF 49(638)956] Unclassified

Presented at meeting of the Amer. Phys. Soc., Florida State U., Tallahassee, Apr. 5-7, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 573, Nov. 23, 1962.

The characteristic energy losses which occur when a beam of electrons pass through a thin metal foil have been observed. The mean free path for excitation of a plasmon has been determined for each metal by studying the dependence of the spectrum on foil thickness and incident electron energy. The experimental procedure for determining the energy losses and a comparison of the experimental and theoretical values for the mean free path are given.

891

Florida U. Dept. of Physics, Gainesville.

ELECTRON TUNNELING THROUGH THIN INSULATING LAYERS (Abstract), by M. F. Panczyk, H. J. Watson, and W. B. Ard, Jr. [1962] [1]p. (Bound with its AFOSR-2937) (AF 49(638)956) Unclassified

The resistance of aluminum oxide films has been determined by recording the current penetrating through the film as a function of the voltage applied across the film. Qualitative agreement with calculations made by Holm has been obtained. For low voltages the current-voltage curve is linear while for higher potentials the current increases rapidly with increasing voltage. Quantitative agreement may be obtained by assuming an effective electron mass of 1/10, which shows that the resistance of the films is lower than the calculated values for vacuum. Work is also being carried out at low temperature where one or both of the metals is in a superconducting phase. (Contractor's abstract)

892

Florida U. [Dept. of Physics] Gainesville.

PLASMA EXCITATIONS BY FAST ELECTRONS IN METALLIC FILMS (Abstract), by H. J. Watson, M. F. Panczyk, and W. B. Ard, Jr. [1962] [1]p. [AF 49-(638)956] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 344, Apr. 23, 1962.

The characteristic electron energy-loss spectra in various metals has been measured by an electron-transmission method. The resolution obtainable with the apparatus allows a determination of the shape of the characteristic-loss lines. Theoretical treatment of the electron-plasmon interaction gives an expression for the dependence of the cross section for plasmon excitation on plasmon wavelength. This together with the dispersion relation for plasmons allows one to predict the shape of a characteristic-loss line due to plasmon excitation. Lines with the expected shape are observed in some metals, particularly aluminum and magnesium, substantiating that the major energy losses in these metals is due to plasmon excitation. However, some lines observed in other metals have shapes that indicate that they are due to some other loss mechanism, possibly an atomic or band-to-band transition.

893

Fordham U. Dept. of Chemistry, New York.

THE CHEMISTRY OF PEOTOTROPIC SYDNONES, by I. M. Hunsberger. Final rept. Sept. 1, 1956 - Aug. 3, 1961. Dec. 30, 1961, 7p. incl. refs. (AFOSR-1945) (AF 18(603)127) Unclassified

This project is concerned with the synthesis of sydnones, the investigation of the chemical structure required for phototropy, and the study of the mechanism of the interconversion of colored and colorless forms. This study may find practical use in color photography and in methods of reproduction as well as contributing to synthetic and structural organic chemistry.

894

Fordham U. Dept. of Chemistry, New York.

A PHOTOTROPIC HETEROCYCLIC DERIVATIVE OF A SYDNONE; A NEW SYNTHESIS OF AN N-SUBSTITUTED GLYCINE; AND A GENERAL SYNTHESIS OF MONOSUBSTITUTED HYDRAZINES, by J. M. Tien and [I.] M. Hunsberger. [1954] [1]p. incl. diagr. (AFOSR-64-1463) (AF 18(603)127) Unclassified

Also published in Chem. and Indus. (London), p. 119-120, Jan. 1955.

The present work demonstrates that a wide variety of sydnones (R = alkyl, cyclo alkyl, aralkyl, aryl, and heteroaryl) can be synthesized by the same general route and in turn hydrolysed to the corresponding monosubstituted hydrazines, thus affording a single method for preparing such hydrazines by a simple hydrolysis of a stable and readily available precursor.

895

Fordham U. Dept. of Chemistry, New York.

NUCLEOPHILIC REACTIONS OF SEMIIONIC OXYGEN. THE REACTION OF ALIPHATIC AND HETEROCYCLIC N-OXIDES WITH α-HALOESTERS (Abstract), by J. M. Tien, I. M. Hunsberger, and A. M. Haveliana. [1959] [1]p. [AF 18(603)127] Unclassified

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

Published in 135th meeting of the Amer. Chem. Soc. Abstract of Papers, 1959, p. 76-O.

The oxidation of a halogen compound to the corresponding carbonyl compound by means of dimethyl sulfoxide apparently proceeds via an ionic intermediate, $(Me_2\overset{\oplus}{S}OCH\langle^{R_2}_{R_1})Br^{\ominus}$, formed by nucleophilic displacement of the halogen by the sulfoxide oxygen. The present work was undertaken as the first part of an attempt to demonstrate that a variety of compounds containing semiionic oxygen atoms can replace dimethyl sulfoxide in such reactions. Thus, both 4-methoxypyridine 1-oxide (I) and trimethylamine N-oxide (II) are able to convert ethyl bromoacetate to ethyl glyoxylate, although the detailed nature of the 2 reactions is different. The striking variations in reactivity toward α-haloesters exhibited by azoxybenzene, I, II, and the N-oxides of N-methyl-morpholine, triethylamine, tributylamine, N,N-dimethylaniline, pyridine, and 4-nitropyridine are discussed in terms of electronic and steric effects on the nucleophilicity of the semiionic oxygen of the N-oxide link.

896

Fordham U. Dept. of Chemistry, New York.

SYNTHESIS AND PROOF OF STRUCTURE OF 9-HYDROXYALDEHYDES AND 9-HYDROXYKETONES IN THE ANTHRACENE SERIES (Abstract), by J. L. Ferrari and I. M. Hunsberger. [1959] [1]p. [AF 18-(603)127] Unclassified

Presented at meeting of the Org. Chem. Div. of the Amer. Chem. Soc., Atlantic City, N. J., Sept. 13-18, 1959.

Published in 136th meeting of the Amer. Chem. Soc., Abstracts of Papers, 1959, p. 21-P.

Previous studies of double-bond character in aromatic systems have been extended to anthracene. The work here indicates that substances such as 2-anthrol can be transformed readily into both 2,1- and 3,2-disubstituted anthracenes. Apparently the end rings of anthracene are more benzenoid than either ring of naphthalene, in rough agreement with valence-bond calculations based on canonical structures which include Dewar types.

897

Fordham U. Dept. of Chemistry, New York.

SYNTHESIS OF SOME SUBSTITUTED PYRIDYLSYDNONES (Abstract), by C. V. Greco and I. M. Hunsberger. [1960] [1]p. [AF 19(603)127] Unclassified

Presented at meeting of the Org. Chem. Div. of the Amer. Chem. Soc., Cleveland, Ohio, Apr. 5-14, 1960.

Published in 137th meeting of the Amer. Chem. Soc., Abstracts of Papers, 1960, p. 71-O.

The phenomenon of phototropy unexpectedly was exhibited by the first N-heteroaryl derivative of a sydnone, i.e. N-(3-pyridyl)sydnone (I). Synthesis of the 1-oxide (II) of N-(3-pyridyl)sydnone, of N-(5-bromo-3-pyridyl)sydnone (III), and of the 1-oxide (IV) of N-(5-bromo-3-pyridyl)sydnone were undertaken in order to study the effect on phototropy exerted by substituents on the pyridine ring. Compounds II and III were prepared via the corresponding aminopyridines and N-pyridylglycines by the general procedure used earlier to prepare I. The required 3-aminopyridine 1-oxide and 3-amino-5-bromopyridine were obtained by Hofmann rearrangement of the corresponding amides. An excellent preparation of 5-bromonicotinamide from nicotinic acid was developed which involves bromination in thionyl chloride, followed by reaction of the bromoacid chloride with ammonia in chloroform. Proof of structure II and III was accomplished by acid hydrolysis to the corresponding hydrazines which were isolated, as acetophenone 3-pyridylhydrazone 1-oxide and as 5-bromo-3-pyridylhydrazine hydrochloride. These products were identical with samples prepared by reduction of the respective diazotized atoms. Although 3-amino-5-bromonicotinamide 1-oxide was prepared conveniently from 5-bromonicotinamide 1-oxide, attempts to prepare the corresponding glycine by catalytic hydrogenation of a mixture of the amine and butyl glyoxylate afforded, in acid solution N-(3-pyridyl)glycine and, in neutral or alkaline solution, the 1-oxide of N-(3-pyridyl)glycine. Both these products resulted from a reductive cleavage of the bromine atom. Neither II nor III was phototropic. Infrared absorption bands characteristic of the CH of the sydnone ring have been identified.

898

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

THE (p,p'γ) REACTION IN EVEN ISOTOPES OF Zn, Ge AND Se, by D. M. Van Patter, R. Rikmenspoel, and P. N. Trehan. [1961] [23]p. incl. diagrs. tables, refs. (AFOSR-3010) (AF 49(638)512) Unclassified

Also published in Nuclear Phys., v. 27: 467-489, Oct. 1961.

For abstract see item no. 756, Vol. V.

899

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

THE PRESENT STATUS OF ATOMIC MASS DETERMINATIONS, by H. E. Duckworth. [1961] [13]p. incl. illus. diagrs. table. (AFOSR-3011) (AF 49(638)512) Unclassified

Presented at meeting of Canadian Associations of Physicists, Sir George Williams U., June 9, 1961.

Also published in Phys. Canad., v. 17: 8-20, Autumn, 1961.

This article discusses the 4 principal sources of atomic mass information and the relative importance of each. These sources include: (1) alpha decay energies which provide important mass data for the atoms heavier than lead; (2) total beta-decay energies; (3) energy balance in provoked reactions, and (4) the mass spectroscopic doublet.

900

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

DECAY OF 18-MIN Br^{80}, by P. N. Trehan and D. M. Van Patter. [1961] [6]p. incl. diagrs. table, refs. (AFOSR-3170) (AF 49(638)512) Unclassified

Also published in Phys. Rev., v. 126: 266-271, Apr. 1, 1962.

For abstract see item no. 758, Vol. V.

901

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

STUDY OF PROPERTIES OF MEDIUM-WEIGHT NUCLEI, by D. M. Van Patter, R. Rikmenspoel and others. Final rept. Nov. 1, 1958 - Oct. 31, 1962, Dec. 31, 1962 [69]p. incl. diagrs. tables, refs. (AFOSR-4422) (AF 49(638)512) AD 297041 Unclassified

The properties of low-lying levels of medium-weight nuclei were of primary interest in these investigations. Initially, comprehensive surveys were carried out of available experimental information concerning the γ-ray decay properties of the first two 2^+ states of the even-even nuclei, together with comparisons to available theoretical predictions, such as provided by the asymmetric rotor model of Davydov and Filippov. The experimental program of γ-ray scintillation spectroscopy began with a feasibility study of γ-radiations from inelastic proton scattering, since it was not known if the γ-ray decay properties of the second 2^+ states of medium-weight nuclei could be investigated by this method. It was found that the yield of such radiations was quite favorable at proton energies of about 5 mev, provided that the (p,n) threshold for the target isotope exceeded about 4.5 - 5.0 mev. An initial survey of (p, p'γ) spectra from isotopes of Zn, Ge, and Se was then carried out, and later extended to the isotopes of Ni. This work provided evidence for several new levels in these isotopes, as well as information concerning the γ-ray branching of second 2^+ levels. The γ-ray spectra from some of these short-lived activities (such as Cu^{62}, Ga^{68}, Br^{78}, and Br^{80}) were subjected to close scrutiny to discover if any new information would be revealed. In the case of the 18-min Br^{80} activity, 5 new γ-ray's were detected. This resulted in a considerable revision of the Br^{80} decay scheme, and provided estimates of the log ft values for allowed beta-transitions from Br^{80} (1+) to the ground-state and first 2 excited states of Se^{80} and Kr^{80}.

902

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

ANGULAR DISTRIBUTIONS OF (p, p'γ) RADIATIONS FROM Ni^{60} AND Ni^{62} (Abstract), by A. K. Sen Gupta, P. N. Trehan, and D. M. Van Patter. [1962] [1]p. [AF AFOSR-62-217] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 81, Jan. 24, 1962.

Self-supporting foils of enriched Ni^{60}(99.2%) and Ni^{62}(97.7%) of 2.6 mgs/cm^2 have been bombarded by protons with E_p = 4.4 to 5.0 mev, incident at an angle of 46°. The target thicknesses were chosen to attempt to provide statistical averaging over many compound states. Angular distributions of prominent (p, p'γ) radiations have been measured for θ = 0 to 150°, using a 3 x 3 in. NaI(Tl) crystal at 14 cm. The observed angular distributions of the ground-state transitions from the 1.33- and 2.16-mev levels of Ni^{60}, and the 1.17- and 2.30-mev levels in Ni^{62}, were similar in nature. The angular distribution of the 0.83-mev cascade γ-ray from the second 2^+ state of Ni^{60} at 2.16 mev showed a considerably greater yield at 0 than at 90°. The angular distribution of the 0.88-mev cascade γ-ray from the second level of Ni^{62} at 2.05 mev appeared to be roughly isotropic. This observation, together with the lack of an observed 2.05 mev ground-state transition (< 0.03 of the intensity of the 0.88-mev γ-ray), is consistent with the possibility that the 2.05-mev level may be 0^+, and that the 2.30-mev level may be the second 2^+ state. The 2.05-mev γ-ray reported previously at $E_p \geq 5.0$ mev should be assigned to the decay of a higher state.

903

Franklin Inst. [Labs. for Research and Development] Philadelphia, Pa.

FIELD DEPENDENCE OF THE SUSCEPTIBILITY IN ANTIFERROMAGNETS (Abstract), by S. Shtrikman. [1962] [1]p. [AF 49(638)159] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 279, Apr. 23, 1962.

The relevance of the second-order terms in the field dependence of the magnetization for the study of weak ferromagnetism has been recently recognized by Treves. Symmetry considerations show that such non-linearity (the "treves effect") may also appear in antiferromagnets. Out of the 59 antiferromagnetic classes, it is allowed in 27. The symmetry of the effect which is closely related to that ferromagnetic effect is in this case either of 2 types, cubic or hexagonal. A classical estimate showed that the magnitude of the Treves effect of 0°K is 10^{-10} emu/ccoe^2 and 4×10^{-8} emu/ccoe^2 for FeF_2 and CoF_2, respectively. From the Landau theory of second-order phase transitions, it was found that near the Néel temperature the Treves effect should vary linearly with the sublattice magnetization. A method which would enable the measurement of this effect on a polycrystal is described.

904

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

OBSERVATION BY ELECTRON MICROSCOPY OF THE FERROMAGNETIC PRECIPITATE IN GOLD-NICKEL SINGLE CRYSTALS, by F. R. L. Schoening and P. J. Flanders. [1962] [3]p. incl. illus. table. [AF 49(638)-158] Unclassified

Published in Philos. Mag., v. 7: 1069-1071, June 1962.

Recent magnetic experiments with gold-nickel specimens have indicated that the Ni-rich precipitates are elongated in the ⟨111⟩ directions of the original supersaturated crystal. The electron microscope study was undertaken in order to obtain an independent test of the interpretation of the magnetic data. The results discussed complicate the interpretation of the magnetic data, since not only the elongated shape but also the plate-like shape of the particles should be taken into account. The previous interpretation of the magnetic data had been based on the assumption of single domain particles. Some of the particles observed appear to be larger than the critical single domain size. It seems, however, appropriate to postpone a discussion of the magnetic results until not only the size and shape but also the orientation of the precipitates has been observed directly by thin film techniques.

905

Franklin Inst. [Labs. for Research and Development] Philadelphia, Pa.

A VARIATIONAL APPROACH TO THE THEORY OF THE EFFECTIVE MAGNETIC PERMEABILITY OF MULTIPHASE MATERIALS, by Z. Hashin and S. Shtrikman. [1962] [7]p. incl. diagrs. [AF 49(638)159] Unclassified

Published in Jour. Appl. Phys., v. 33: 3125-3131, Oct. 1962.

Variational theorems are established and applied to the derivation of bounds for the effective magnetic permeability of macroscopically homogeneous and isotropic multiphase materials. For reasons of mathematical analogy the results are also valid for the dielectric constant, electric conductivity, heat conductivity, and diffusivity of such materials. For the case of 2 phase materials, the bounds derived are the most restrictive ones that can be given in terms of the phase permeabilities and volume fractions. Comparison of present theoretical results with existing experimental data shows good agreement. (Contractor's abstract)

906

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

A STUDY OF THE PLASTIC DEFORMATION OF METALS BY THE OBSERVATION OF SINGLE DISLOCATIONS, by H. G. F. Wilsdorf. Final rept. Dec. 21, 1956 - Feb. 28, 1962 [60]p. incl. illus. diagrs. tables, refs. (Rept. no. F-A2027) (AFOSR-2777) (AF 49(638)-162) AD 278554 Unclassified

Research was aimed to further the understanding of the mechanism of plastic flow in metals. This goal was approached by making use of new submicroscopical techniques which allow atomistic lattice defects to become visible to the naked eye, and by utilizing macroscopic measurements of highest sensitivity. The development and the efforts to perfect 3 selected experimental techniques, namely, 2 methods for observing dislocations directly as well as microstrain measurements, are discussed. The results explain the plastic behavior of alpha - brass in terms of glide dislocations which are most important lattice defects responsible for plastic flow in this metal. For the first time, it has been possible to obtain quantitative data pertaining to the general behavior and the motion of dislocations, including the frictional force acting on the dislocations, during glide. (Contractor's abstract)

907

Franklin Inst. [Labs. for Research and Development] Philadelphia, Pa.

DISLOCATION MECHANISMS IN 70/30 CuZn DEDUCED FROM PRECISION STRESS-STRAIN MEASUREMENTS (Abstract), by P. R. Strutt. [1962] [1]p. [AF 49(638)-162] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 198, Mar. 26, 1962.

Accurate stress-strain measurements have been made on single crystals of 70/30 CuZn of diameter 0.5-0.6 mm with a 2-cm gauge length. The smallest measurable strain is $\sim 10^{-6}$, and the pre-yield microstrain and yield-point regions have been examined at high-strain sensitivities. There is a departure from the elastic-unloading curve before zero load is reached, and a closed hysteresis loop is formed on reapplication of the load. This anelastic behavior is attributed to relaxing groups of dislocations, and the frictional force can be evaluated. To gain further insight on dislocation distributions and interactions, electron-transmission studies have been made on thin films prepared from bulk specimens. These confirm the concept that dislocations are arranged in groups and that sets of dislocations on nearby slip planes strongly interact elastically. Heavy deformation can occur in isolated regions at a strain of only $\sim 10^{-3}$, and several systems may operate. Dislocations of different systems can react to form sub-boundaries. Generally, however, single slip greatly predominates even for crystal strained 10^{-1} near a crystallographic-symmetry position.

908

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

RESEARCH IN THE GENERAL FIELD OF SUBSTRUCTURE AND DISLOCATION NETWORKS IN METALLIC CRYSTALS, by V. V. Damiano, G. S. Tint, and M. Herman. Final rept. Apr. 1, 1960 - Apr. 30, 1962, 44p. incl. illus. diagrs. refs. (AFOSR-2574) (AF 49-(638)821) Unclassified

The three dimensional aspects of dislocation substructures were studied in cadmium doped zinc crystals grown from the melt. Precipitates delineating the dislocations were revealed by etching a surface closely parallel to the slip plane. Using a technique of continuous etching and cinephotomicrography, the course of the dislocations was followed through the crystal. Tangles of dislocations were observed in deformed crystals. After annealing, a rearrangement of dislocations into low-angle and hexagonal networks was evidenced. Closed loops and spiral dislocations were found to be associated with large inclusions. A mechanism for the multiplication of dislocations at inclusions was proposed. Dislocation reactions accounting for the observed substructures have been proposed. (Contractor's abstract)

909

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

EXPERIMENTAL DETERMINATION OF STABILITY BOUNDARIES FOR AN EXTERNALLY PRESSURIZED, GAS-LUBRICATED THRUST BEARING, by C. Stevenson and L. Licht. Feb. 1962, 35p. incl. diagrs. tables. (Rept. no. I-A2049-19) (Sponsored jointly by [Air Force Office of Scientific Research] and Office of Naval Research under Nonr-234200, Atomic Energy Commission, Dept. of Defense, Maritime Administration, and National Aeronautics and Space Administration) AD 272899 Unclassified

Stability boundaries are determined experimentally for a circular, externally-pressurized air-lubricated thrust bearing. The loci are presented on load vs supply pressure plots, showing the effects of variation of the following parameters on the stability of a 5 in. diameter bearing with a 1 in. diameter, centrally located recess; (1) recess depth, (2) total throat area of supply nozzles, and (3) rotor mass. The influence of entrance effects in the region of admission of the bearing gap is investigated qualitatively. Results are discussed with reference to stable bearing design and operation and recommendations are made for future theoretical and experimental work. (Contractor's abstract)

910

Free U. of Brussels (Belgium).

AUDITORY-EVOKED POTENTIALS FROM COCHLEA TO CORTEX AS INFLUENCED BY ACTIVATION OF THE EFFERENT OLIVO-COCHLEAR BUNDLE, by J. E. Desmedt. [1962] [19]p. incl. illus. diagrs. refs. (AFOSR-J169) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)120 and National Institute of Neurological Diseases and Blindness) AD 400431 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 34: 1478-1496, Sept. 1962.

The crossed olivo-cochlear bundle (OCB) of Rasmussen was stimulated stereotaxically on cats immobilized by Flaxedil and prepared either under pentobarbital, or chloralose, or with a high-spinal section. Middle-ear muscles were cauterized. The efferent effects on sound-evoked potentials were titrated as equivalent dB changes in sound energy by a matching procedure taking into account the intensity function of the responses to sound alone. Maximal inhibition of the N_1 auditory-nerve response to clicks was equivalent to a ~25-dB decrease. The potentials evoked in cochlear nucleus, superior olive, inferior colliculus, medial geniculate, and auditory I area of the cerebral cortex when expressed similarly in equivalent dB changes, disclosed a decrease proportional to that of N_1. The anomalous Ruben-Sekula effect was shown not to involve the OCB inhibition but to depend on a cortical refractory state subsequent to spurious stimulation of second-order auditory axons by inadequately placed electrodes. With suitable precaution, pure OCB stimulation was achieved in most of the experiments, and interference from this effect thus excluded. The OCB activation also paradoxically potentiates the cochlear microphonic potential, but the change amounted at most to a +4 equivalent-dB increase in sound energy. Various parameters of OCB

effects were analyzed in detail; voltage, duration, frequency and number of shocks delivered to the bundle and interval between the conditioning stimulation and the testing sound. More than 3 shocks at a frequency higher than 50/sec are needed to produce detectable changes in N_1 or CM and 40 shocks at 400/sec will generally produce maximal effects. (Contractor's abstract)

911

Free U. of Brussels (Belgium).

[MECHANISM OF THE ACTION OF THE RETICULAR FORMATION ON THE REACTIVE ACTIVITY OF THE CEREBRAL CORTEX] Mécanisme d'action de la formation réticulaire sur l'activité réactionnelle de l'écorce cérébrale, by V. Bonnet. [1962] [3]p. incl illus. (AFOSR-J407) (AF 61(052)120) Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 254: 2081-2083, Mar. 1962.

The work devoted to the effects of the ascending reticular system on the spontaneous electrical potentials and its evoked derivatives on the surface of the cerebral neocortex have not established the nature of the working mechanism. The important points of the mechanism are registered in the depth of the cortex, thus making a different approach necessary. The observations of this paper are carried out on different sensory areas of the cat. The electrical activity was caused, by the stripped end of a steel microelectrode. Under these conditions, the participation in the discharge of the most numerous neurons may be attributed to the lowering of the observed discharge of the nerve on the facil response. This reduction of critical voltage in the discharge of the nerve cells seems to be the base of the facilitation pheonn.enon, resulting in the superposition of the reactive synpatic potential to a preliminary dipolarization.

912

Free U. of Brussels (Belgium).

[STUDY OF AN INHIBITORY PHENOMENON OF WEDENSKI AT THE CORTICAL LEVEL] Étude d'un phénomène d'inhibition de Wedenski au niveau cortical, by F. Bremer and N. Stoupel. [1962] [16]p. incl. illus. refs. (AFOSR-J413) [AF 61(052)120] AD 414180 Unclassified

Also published in Arch. Ital. Biol., v. 100: 399-414, Oct. 1962.

In the cat, the response of the primary auditory area to repetitive sensory stimulation is presented, starting at a frequency of about 10 clicks per sec. At this frequency, Wedenski inhibition appears and is characterized by the disappearance of the highly amplified surface-negative component and by the indefinite persistance of very short surface-positive potentials. The mechanism of an intracortical, homosynaptic blockage of sensory influxes and the mechanism of its self-maintenance are discussed.

913

Free U. of Brussels (Belgium).

[THOUGHTS ON THE PROCESS OF CENTRAL INHIBITION] Considérations sur les processus d'inhibition centrale, by F. Bremer. [1962] [8]p. incl. refs. (AFOSR-J417) (AF 61(052)120) AD 414184 Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 139: 152-158, Sept. 1, 1962.

The distinction between presynaptic and postsynaptic inhibition is discussed. The determination of the inhibitory process, their distinctive pharmacological properties, their particular functions, and their place in the neuralogical mass, particularly in the cerebral exterior are also considered.

914

Free U. of Brussels (Belgium).

[ELECTROPHYSIOLOGICAL STUDY OF BINOCULAR INTERACTION IN THE CORTICAL VISUAL AREA OF THE CAT] Étude électrophysiologique de l'interaction binoculaire dans l'aire visuelle corticale du Chat, by F. Bremer. [1962] [4]p. incl. illus. (AFOSR-J419) (AF 61(052)120) AD 414188 Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 255: 2040-2043, Oct. 1962.

Photic stimulation of the cat's retina or electrical shock of the optic nerves confirms the fact that the binocular interaction is very important to the cortical level. The neuron convergence contrasts with the segregation maintenance of the visual influx in the lateral geniculate body. One of the most interesting manifestations of this convergence is the marked facilitation of the cortical response produced by the slow addition of 2 shocks to the optic nerve applied simultaneously or at very short intervals. The characteristics of this phenomenon are very similar to those of the facilitation of the monosynaptic spinal reflex through heterosynaptic convergence.

915

Free U. of Brussels (Belgium).

[SLEEP CAUSED IN THE RABBIT BY STRONG CEPHALIC AND CERVICAL STIMULATION] Sommeil provoqué chez le Lapin par des stimulations profondes Céphaliques et cervicales, by P.-C. Van Reeth and A. Capon. [1962] [3]p. incl. illus. (AFOSR-J421) (AF 61-(052)120) AD 414187 Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 255: 3050-3-52, Nov. 26, 1962.

The mechanism for mechanical stimulation of the brain of an awake rabbit which brings about electroencephalographic signs of sleep is discussed.

916

Free U of Brussels (Belgium).

ON THE EXISTENCE OF CROSS FLOWS IN SEPARATED SUPERSONIC STREAMS, by J. J. Ginoux. Feb. 1962 [75]p. incl. illus. diagrs. table. (Technical note no. 2) (AFOSR-3422) (AF 61(052)350) AD 274761 Unclassified

An experimental investigation was made on laminar separated supersonic streams using 2-dimensional backward-facing step models. It was shown that a cross-flow existed in the separated region of the flow which is associated with the side wall boundary-layers. Its effect is to decrease the base pressure and increase the pressure gradient at reattachment even for large values of the model-span to step-height ratio. It is shown that the commonly accepted assumption that a 2-dimensional flow exists when there is no measurable spanwise pressure variation is a necessary but not sufficient condition. In the turbulent case, it is generally found that the measured base pressure is lower than is theoretically predicted. This is explained by the existence of a cross-flow (suction) produced by strong vertical vortices near the side walls. (Contractor's abstract)

917

Free U. of Brussels (Belgium).

EFFECT OF GAS INJECTION IN SEPARATED SUPERSONIC FLOWS, by J. J. Ginoux. Final rept. Feb. 1962 [36]p. incl. illus. diagrs. table, refs. (Technical rept. no. 7) (AFOSR-3764) (AF 61(052)350) Unclassified

An experimental investigation has been made at a Mach number of 2.21 on the effect of air injection in separated supersonic flows using 2-dimensional backward facing step models. This effect, in a laminar flow, was found to be independent of the particular technique of injection when the rate of injection was small. Air injection raises the base pressure and decreases the pressure gradient at reattachment. At high rates of injection, considerable differences are found between the results obtained for various techniques of injection. It was also shown that the increase of the base-pressure is larger in the turbulent case than for a laminar boundary layer. When freon gas was injected, it produced the opposite effect, namely of decreasing the base-pressure at low rates of injection. (Contractor's abstract)

918

Free U. of Brussels (Belgium).

PHOTOCHEMISTRY SYMPOSIUM; ABSTRACTS OF PAPERS, by [P. Goldfinger] June 18-22, 196[illegible] [65]p. incl. diagrs. tables, refs. (AFOAR-2980A) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)622, Banque de Bruxelles, European Research Associates, Gevaert Photo-Producten, and Institut International de Chimie et de Physique) AD 278125 Unclassified

Also published in Bull. Soc. Chim. Belg., v. 71: 641-936, Nov.-Dec. 1962.

For abstract see item no. 919, Vol. VI.

919

Free U. of Brussels (Belgium).

PHOTOCHEMISTRY SYMPOSIUM, by [P. Goldfinger] June 18-22, 1962 [296]p. incl. illus. diagrs. tables, refs. (AFOSR-2980B) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)622, Banque de Bruxelles, European Research Associates, Gevaert Photo-Producten, and Institut International de Chimie et de Physique) Unclassified

Also published in Bull. Soc. Chim. Belg., v. 71: 641-936, Nov.-Dec. 1962.

This is a report of the papers presented at the Photochemistry Symposium in Brussels. It includes the entire papers of some and only the abstracts of others. Some of the topics discussed are: effect of temperature and viscosity on the true first order decay of the triplet state of aromatic molecules, photochemical studies in flash photolysis, and photolysis of dialkyl disulfides in an organic matrix at 77°K.

920

Free U. of Brussels (Belgium).

[ON THE CENTRIFUGAL INHIBITION PHENOMENON IN THE CENTRAL ACOUSTICAL PATHWAY IN THE BRAIN OF THE CAT] Sur un phénomène d'inhibition centrifuge dans la voie acoustique centrale chez le Chat, by J. E. Desmedt and K. Mechelse. [1957] [4]p. incl. illus. (AF 61(514)1112) AD 632615 Unclassified

Also published in Compt. Rend Séances Soc. Biol., v. 151: 2209-2212, Dec. 21, 1957.

There exists little experimental data on the precise architecture and function of the centrifugal pathways capable of acting as a filter for the sensory messages to the nevers from the diverse relay station. This report concerns the acoustical pathway in the brain of the cat. The conclusion drawn from this study is that all the mesencephalic inhibitor points studied are localized to the immediate proximity of the specific acoustical pathway and clearly outside of the reticular formation.

921

Free U. of Brussels (Belgium).

[EFFECTS OF THE TEMPERATURE ON THE DEVELOPING STAGE OF A TEMPERATE BACTERIOPHAGE]

Effects de la température sur les étapes du développement d'un bactériophage tempéré, by J. Lecointe-Hardt and R. Thomas [1962] [2]p (AFOSR-4205) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-62-17, Belgian Fonds National de la Recherche Scientifique, and Euratom) Unclassified

Presented at Thirty-seventh meeting of Soc. Belge de Biochim., Gembloux (France), Mar. 17, 1962.

Also published in Arch. Internat'l. Physiol. Biochim., v. 70: 404-405, 1962.

The recent work of Lwoff draws attention to the sensitivity of the reproduction of the virus toward temperature. The present work concerns the influence of temperature on the development of a temperate bacteriophage after induction of a lysogenic strain of Escherichia coli derived from the C600 strain. The major results are outlined.

922

Free U. of Brussels (Belgium).

ON THE OCCURRENCE OF BACTERIAL MUTATIONS PERMITTING LYSOGENIZATION BY CLEAR VARIANTS OF TEMPERATE BACTERIOPHAGES, by R. Thomas and L. Lambert. [1962] [2]p. incl. refs. (AFOSR-3179) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-62-17, Belgian Fonds National de la Recherche Scientifique, and Euratom) AD 400341 Unclassified

Also published in Jour. Molec. Biol., v. 5: 373-374, Sept. 1962.

This paper describes a class of single-step bacterial mutations (temperator mutations) which alter the response after infection. The mutated strains can be lysogenized by the clear mutant λC_{72}, which belongs to class c_1 and does not lysogenize the indicator strain C600 to any measurable extent under the usual conditions. A streptomycin resistant (Sm^r) derivative of C600 was found to yield turbid plaques when used as an indicator for λC_{72}. From such turbid plaques, and also from survivors of a multiple infection with λC_{72} in liquid medium, strains of C600 were isolated which could be shown to be lysogenic for λC_{72}. After repeated single colony isolations and 2 treatments with specific antiserum, these strains have the following properties: (1) they are immune to λ which does not produce plaques on these bacteria; (2) each colony produces a halo when replica-plated onto a sensitive strain; (3) they can be induced to lyse, liberating phages which are apparently identical with λC_{72}, and (4) derivatives unable to adsorb λ still liberate phage, a fact which excludes the hypothesis of a carrier state.

923

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

STATISTICAL MECHANICS OF NON-EQUILIBRIUM PROCESSES, by I. Prigogine. Final rept. Apr. 1, 1962, 1v. incl. diagrs. refs. (AFOSR-2690) (AF 61(052)179) AD 289161 Unclassified

A general theory of irreversibility is constructed from the perturbation analysis of the Liouville equation in Fourier space, which essentially takes the form of a dynamics of correlations. General kinetic equations valid to all orders of the parameters of the system are derived and a generalized H-theorem is proved. The extension of the theory to inhomogeneous systems is made. The formal analogy between the Liouville and the Von Neumann equations provides the basis for the complete transposition of the theory to quantum mechanics. In its applications to plasmas, both quantum and classical, the theory leads in particular to kinetic equations which give a rigorous expression of the collective nature of the Coulomb interactions. The Liouville formalism also finds interesting applications in classical electrodynamics. An example, a non-markoffian equation for electron motion is derived which exhibits none of the unphysical solutions usually encountered. (Contractor's abstract)

924

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

MONOGRAPHS IN STATISTICAL PHYSICS AND THERMODYNAMICS. VOL. I. NON-EQUILIBRIUM STATISTICAL MECHANICS, by I. Prigogine. New York, Interscience Publishers, 1962, 319p. incl. diagrs. refs. [AF 61(052)179] Unclassified

The main goal of this book is to obtain a general theory of non-equilibrium processes by reformulating the entire problem in a more systematic way on a purely mechanical basis. Some of the topics discussed are: Liouville Equation, Anharmonic solids, Brownian motion, Approach to equilibrium in ionized gases, and General kinetic equations.

925

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

KINETIC EQUATION FOR AN UNSTABLE PLASMA, by R. Balescu. 1962, 39p. incl. illus. refs. (AFOSR-3487) (AF EOAR-62-16) AD 285451 Unclassified

A kinetic equation is derived for the description of the evolution in time of the distribution of velocities in a spatially homogeneous ionized gas which at the initial time is able to sustain exponentially growing oscillations. This equation is expressed in terms of a functional of the velocity distribution which obeys the same integral equation as in the stable case. The nature of the solution changes radically under unstable conditions

is shown. This integral equation is solved exactly and hence an explicit form of the kinetic equation is obtained. The latter contains the 'normal' collision term and a new additional term describing the stabilization of the plasma. The latter acts through friction and diffusion and brings the plasma into a state in which the velocity distribution is on the verge of stability. The stabilizing term vanishes and the plasma evolves towards thermal equilibrium under the action of the normal collision term alone. (Contractor's abstract)

926

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

EQUIVALENCE BETWEEN THE TWO GENERALIZED MASTER EQUATIONS, by S. Fujita. [1961] [43]p. incl. diagrs. refs. (AFOSR-3736) [AF EOAR-62-16] AD 289191 Unclassified

Also published in Physica, v. 28: 281-297, Mar. 1962.

For abstract see item no. 808, Vol. V.

927

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

CORRELATIONS IN A NON-ISOTHERMAL PLASMA, by I. Prigogine and P. de Gottal. [1962] [8]p. (AFOSR-3944) (AF EOAR-62-16) AD 290053 Unclassified

Also published in Physica, v. 29: 706-711, June 1963.

It is well known that ions and electrons at different temperatures can coexist in a plasma at low enough pressure. The canonical distribution cannot then be used to calculate electron-ion correlations or the equation of state. Nevertheless, the method developed by Prigogine and co-workers can still be used to calculate these quantities in terms of the corresponding creation diagrams. In this method, the correlations are seen as due to the mutual scattering of ions and electrons with the double Maxwell distribution as an asymptotic condition. (Contractor's abstract)

928

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

APPROACH TO EQUILIBRIUM OF A MANY-PARTICLE SYSTEM, by S. Fujita. [1962] [58]p. incl. diagrs. refs. (AFOSR-3945) (AF EOAR-62-16) Unclassified

Presented at Summer Inst. in Theoretical Physics, Brandeis U., Waltham, Mass. , 1962.

Also published in Statistical Physics, v. 3: ed. by K. W. Ford, New York, W. A. Benjamin, Inc., 1963, 219-252.

An expanded version of a previous paper by the author relating the Van Hove and Prigogine-Résibois generalized master equations for a system of interacting particles is presented. An outline of Résibois' proof that the average value of an arbitrary intensive quantity approaches equilibrium is also included.

929

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

MOTION OF A RELATIVISTIC CHARGED PARTICLE, by I. Prigogine and F. Henin. [1962] [22]p. incl. diagrs. refs. (AFOSR-64-0057) (AF EOAR-62-16) AD 431165 Unclassified

Also published in Physica, v. 28: 667-688, July 1962.

A covariant formalism is developed which contains both relativistic Lorentz-Dirac (point-particle) electrodynamics and the Sommerfield electron theory as special cases. Since this is a proper relativistic generalization of the extended charge model, difficulties concerned with run-away solutions, negative definite energies, and auxiliary fields are avoided ab initio. The essential point of this approach is to cut off the momentum representation of the vector potential in an invariant way- the scalar product of the velocity and wave 4-vectors is used to fix this quantity. Various dynamical consequences of the formalism are discussed. In particular, it is pointed out that for times short compared to the electron transit time, force free self-oscillations may appear.

930

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

SOME COMMENTS ON THE STATISTICAL MECHANICS OF IRREVERSIBLE PROCESSES IN GASES, by R. Balescu. [1962] [6]p. [AF EOAR-62-16] Unclassified

Published in Canad. Jour. Phys., v. 40: 1664-1669, Nov. 1962.

The objections formulated by Wu against the theory of irreversible processes developed by Prigogine and the author are discussed and shown to be incorrect. (Contractor's abstract)

931

[Free U. of Brussels. Lab. of Animal Morphology] (Belgium).

ROLE OF SULFHYDRYL AND DISULFIDE GROUPS, by J. Brachet. Final rept. Feb. 1, 1960-Mar. 31, 1962. Apr. 31, 1962, 21p. incl. refs. (AFOSR-2668) (AF 61(052)356) AD 401257 Unclassified

Research was conducted to extend previous observations of the effects of -SH and -SS-groups on some biological systems and to analyze in greater detail the

results regarding the role of thiol groups in morphogenesis. The possible effects of mercaptoethanol and dithiodiglycol on cell division in systems which had not yet been examined in this respect were also studied. The aim of these latter experiments was to find out whether mercaptoethanol inhibits cell division by a specific action on the mitotic apparatus, as suggested by Mazia.

932

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

EFFECTS OF β-MERCAPTOETHANOL AND LIPOIC ACID ON MORPHOGENESIS, by J. Brachet. [1962] [3]p. (AFOSR-3457) (AF 61(052)356) Unclassified

Also published in Nature, v. 193: 87-88, Jan. 1962.

The new observations concerning the biological and biochemical effects of mercaptoethanol and lipoic acid on developing amphibian eggs are discussed. It can be concluded from the experiments described that lipoic acid, if used at a sufficient concentration, is as efficient as mercaptoethanol in stopping morphogenesis; the biochemical mode of action of the 2 substances is certainly complex and it remains to be seen whether they act on the same metabolic step or not.

933

Free U. of Brussels. [Lab. of Animal Morphology] (Belgium).

[THE EFFECTS OF β-MERCAPTOETHANOL AND DITHIODIGLYCOL ON THE GROWTH OF ESCHERICHIA COLI AND OF SACCHAROMYCES CEREVISIAL] Les effets du β-mercaptoethanol et du dithiodiglycol sur la croissance of eschericia coli et de saccharomyces cerevisiae, by S. Limbosch-Rolin. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-J466) (AF 61(052)356) AD 412872 Unclassified

Also published in Exper. Cell Research, v. 29: 61-72, Jan. 1962.

The effects of β-mercaptoethanol, a reducing substance with a -SH group, on the growth and redox potential of bacterial and yeast cultures have been studied. Both substances inhibited cell division in these microorganisms, but this action does not appear to be due to any change in the redox potential of the culture medium. The reduction of dithiodiglycol to mercaptoethanol in the presence of bacteria and yeasts can be attributed to the action of a disulfide reductase identified in yeasts by Thompson. The respiratory process does not appear to be the essential target of mercaptoethanol inhibition, since the latter occurs whether the yeast cells are able to respire or not.

934

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

THE EFFECTS OF β-MERCAPTOETHANOL ON THE MORPHOGENETIC MOVEMENTS OF AMPHIBIAN EMBRYOS, by P. Malpoix, J. Quertier, and J. Brachet. [1962] [12]p. incl. diagrs. refs. (AFOSR-3566) (AF 61(052)356) AD 406783 Unclassified

Also published in Jour. Embryol. and Exper. Morphol., v. 11: 155-166, Mar. 1963.

Explant systems and vital straining were used to study the specific effects of various concentrations of β-mercaptoethanol on the morphogenetic movements of amphibians. Three different types of effect were observed: (1) rapid but reversible inhibition of neurulation, becoming irreversible after prolonged treatments (2) slow, progressive inhibition of epiboly, convergent stretching and ingression; and (3) very slight inhibition of invagination, occurring only at high concentrations or after prolonged treatments. The significance of these results is discussed. (Contractor's abstract)

935

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[SULFHYDRIL GROUPS AND MORPHOGENESIS. III. BIOCHEMICAL STUDY OF THE EFFECTS OF MERCAPTOETHANOL ON THE EMBRYOS OF AMPHIBIA AND THE ALGA ACETABULARIA] Groupes sulfhydriles et morphogénèse III. Etude biochimique des effets du mercaptoethanol sur les embryons de batriciens et l'algue Acetabularia mediterranea, by J. Brachet, M. Decroly, and J. Quertier. [1962] [19]p. incl. tables, refs. (AFOSR-J568) (AF 61(052)356) AD 407388 Unclassified

Also published in Develop. Biol., v. 6: 113-131, Feb. 1963.

The biochemical effects of β-mercaptoethanol (which inhibits neural tube closure) have been studied in amphibian gastrulae and neurulae, and in the alga Acetabularia. It has been found that: (1) Total and acid soluble -SH groups definitely increase in mercaptoethanol-treated eggs, (2) S^{35}-Mercaptoethanol is incorporated into the proteins of both amphibian embryos and Acetabularia. The radioactivity of the proteins represent 25% of the total radioactivity in the treated eggs and varies between 10 and 25%, according to culture conditions, in Acetabularia; (3) Autoradiography observations and work on homogenates have shown that S^{35}-mercaptoethanol is incorporated mainly into the pigment granules and yolk platelets of the animal half and later, of the dorsal half of the embryo. In Acetabularia, the incorporation is highest in the nucleus and in the apical part of the stem; (4) It was not possible to detect by electrophoresis the appearance of a new soluble -SH-containing protein in mercaptoethanol-treated eggs. Most of the radioactivity is found in the basic protein fraction after treatment with S^{35}-mercaptoethanol of amphibian eggs; and (5) Amphibian eggs contain no ecto-ATPase, and mercaptoethanol treatment has no appreciable effect on their endo-ATPase. The significance of these results for an explanation of the morphostatic effects of mercaptoethanol is discussed.

936

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[SULFHYDRIL GROUPS AND MORPHOGENESIS. IV. EFFECTS OF β-MERCAPTOETHANOL AND α-LIPOIC ACID ON THE METABOLISM OF NUCLEIC ACIDS IN AMPHIBIAN AND CHICKEN EMBRYOS] Groupes sulfhydriles et morphogénèse IV. Effets du Mercaptoéthanol et de L'acide-α-Lipoique sur le métabolisme des acides nucléiques chez les embryons de batracien et de Poulet, by V. Pohl and J. Ouertier. [1962] [13]p. incl. tables, refs. (AFOSR-J569) (AF 61-(052)356) AD 407386 Unclassified

Also published in Jour Embryol. and Exper. Morphol., v. 11: 293-305, Mar. 1963.

A study was made of the incorporation of nucleic acid precursors (thymidine, uridine, cytidine) in 2 embryonic materials: Pleurodeles and Chicken, in the presence of 2 substances known to have a morphostatic effect on the closure of the neural plate: β-mercaptoethanol and lipoic acid. The results reveal a marked similarity of action. Thymidine incorporation into DNA is stimulated by mercaptoethanol and lipoic acid. Both substances also stimulate the incorporation of cytidine and uridine into RNA. But there is a difference in the case of DNA: mercaptoethanol has a slight stimulatory effect on the incorporation of the 2 nucleosides, whereas lipoic acid is definitely inhibitory. All the evidence suggests a specific effect of lipoic acid on the reduction of ribonucleosides to deoxyribonucleosides. (Contractor's abstract)

937

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

SULFHYDRYL GROUPS AND MORPHOGENESIS. I. EFFECTS OF β-MERCAPTOETHANOL, α-LIPOIC ACID, ATP, AND OXALOACETATE ON EMBRYONIC DEVELOPMENT IN AMPHIBIANS] Groupes sulfhydriles et morphogénese. I. Effets du β-mercaptoéthanol, de l'acide α-lipoique, de l'acide adénosinetriphosphorique et de l'oxaloacétate sur le développement embryonnaire des Batraciens, by J. Brachet. [1962] [18]p. incl. illus. refs. (AFOSR-65-2244) (AF 61(052)356) AD 629461 Unclassified

Also published in Develop. Biol., v. 7: 348-364, Mar. 1963.

The effects of mercaptoethanol, lipoic acid, ATP and oxaloacetate, alone or in combination, have been studied in eggs of 4 different species of amphibians. The effects of mercaptoethanol (M/100) and lipoic acid (30-30mg/ml) are remarkably similar; cleavage is little affected, but gastrulation and neural plate closure are strongly inhibited. At lower concentrations, the outgrowth of the tail is strongly reduced. Mercaptoethanol and lipoic acid, if mixed together, have additive effects. ATP, which speeds up neural plate closure, is antagonistic to both mercaptoethanol and lipoic acid so far as neurulation is concerned. It has no effect on the outgrowth of the tail. Oxaloacetate, like other tricarboxylic cycle intermediates, has unfavorable effects on neural tube closure. It often improves the elongation of the tail in lipoic acid-treated embryos. (Contractor's abstract)

938

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

NUCLEIC ACIDS IN DEVELOPMENT, by J. Brachet. [1962] [18]p. incl. illus. diagr. refs. (AFOSR-J205) (AF EOAR-61-31) AD 400445 Unclassified

Presented at Symposium on Specificity of Cell Differentiation and Interaction, Gatlinburg, Tenn., Apr. 9-12, 1962.

Also published in Jour. Cellular Comp. Physiol., v. 60, Suppl. 1: 1-18, Oct. 1962.

A summary is presented of current knowledge about DNA, RNA, and protein interactions during morphogenesis. Two biological systems, amphibian eggs and the unicellular alga, Acetabularia, is described from that viewpoint. An attempt is made to integrate the biological and biochemical observations on these 2 morphogenetic systems in a more general hypothesis of differentiation at the molecular level.

939

Free U. of Brussels. Lab. of Molecular Chemistry and Physics (Belgium).

[MASS SPECTROSCOPY STUDIES FOR HIGH TEMPERATURE CHEMISTRY. EVAPORATION OF ELEMENTS AND DISSOCIATION ENERGIES OF DIATOMIC MOLECULES] Etudes par spectrometrie de masse en chimie des hautes temperatures. Evaporation d'elements et de composes energies de dissocation de molecules biatomiques, by J. Drowart. [1957] [106]p. incl. diagrs tables, refs. (AF 61(514)868) AD 622880 Unclassified

A mass spectrometer has been designed to study the evaporation of solids and liquids at a temperature near 2000°K. This instrument enables one: (1) to confirm the generally acceptable values for the latent heat of sublimation or evaporation of Ge, Ga, Cr Ni, Cu, Ag, and Au; (2) to confirm the composition of the gaseous phase of Ge; (3) to show that the vapor of the elements Ga, Cr, Mn, and Ni contains less than 0.01% molecules; (4) to show that the vapor of the elements Cu, Ag, and Au contain about 0.1% molecules at 1300° to 15000°K 15000°K; (5) to determine the energies of dissociation of the molecules Cu_2, Ag_2 and Au_2 - $D(Cu_2) = 2.0_2 \pm 0.1$ ev, $D(Ag_2) = 1.6_3 \pm 0.1$ ev, $D(Au_2) = 2.1_8 \pm 0.1$ ev; (6) to show that the intermetallic composition of GaAs, InP, InSb, and CdTe decomposes at the moment of

evaporation; and (7) to put into evidence some secondary reactions between ions and molecules. The effective sections of these processes as well as some reactions between excited atoms and ions are established with this gas spectrometer. (Contractor's abstract, modified)

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Free U. of West Berlin (Germany).

VOLUME CONDITIONED STIMULI AFFECTING SALT AND WATER EXCRETION, by O. H. Gauer, K. Pabst and others. Final rept. Sept. 1962 [125]p. incl. illus. diagrs. tables, refs. (AFOSR-4983) (AF 61(052)31) AD 631923 Unclassified

This is a collection of 8 reprints concerned with the study of excretion. Some of the general areas covered are: body fluids, salts, blood circulation, kidneys, veins, and hypoxia.

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Free U. of West Berlin (Germany).

[KIDNEY FUNCTION DURING BILATERAL CLAMPING OF THE CAROTID ARTERIES IN THE DOG] Die Nierenfunktion wahrend doppelseitiger Carotisabklemmung am wachen Hund, by L. Sommyay, H. L. Thron and others. [1962] [25]p. incl. diagrs. tables, refs. (AFOSR-J458) Unclassified

Also published in Pflugers Arch. Physiol., v. 276: 117-141, 1962.

The effect of occluding both common carotid arteries for 90-150 min on PAH- and inulin-clearance, on excretion of urine, Na, K, Cl and total solids, and on urine osmolarity was studied. The results were as follows: (1) During occlusion of the carotid arteries, the NaCl-excretion as well as the osmolar clearance increases significantly, the magnitude of the rise depending on the level of electrolyte excretion before the occlusion. K-excretion showed a slight increase. The changes in Na-Cl-excretion were promptly reversible after ending the occlusion; (2) Neither urine excretion, osmotic U/P ration nor excretion resp. reabsorption of osmotic free water revealed definite changes. From these results, it remains questionable if changes in renal medullary blood flow are mainly involved in the kidney's response to carotid occlusion; and (3) With renal blood flow remaining nearly unchanged, glomerular filtration rate as well as filtration fraction increased definitely in most of the experiments, in which NaCl-excretion showed an increase too. The increase in electrolyte excretion during carotid occlusion is discussed as being caused mainly by the observed increase in glomerular filtration rate which itself is induced by the rise in arterial blood pressure.

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Free U. of West Berlin (Germany).

[THE ELIMINATION FUNCTION OF THE KIDNEY AFTER RAPID INFUSION OF COOKING SALT AND COOKING SALT FREE SOLUTION] Die ausscheidungsfunktion der niere nach schneller infusion kochsalzhaltiger und kochsalzfreier lösung, by K. Pabst. [1961] [10]p. incl. diagrs. tables, refs. (AF 61(052)31) Unclassified

Also published in Pflügers Arch. ges Physiol., v. 273: 315-324, July 1961.

Renal function was investigated in unanesthetized dogs during rapid expansion of blood volume and extracellular fluid volume by rapid infusion of isotonic saline and hypotonic dextrose solutions. The typical excretion pattern could be divided into 3 phases (phase 1 (1-30 min), phase 2 (31-90 min), and phase 3 (91-300 min) after beginning of infusion. Phase 1 was characterized by a fast rise of glomerular filtration rate and renal plasma flow and an increase in urine volume and sodium excretion in both groups. In phase 2 and 3, the influence of GFR and RPF was reduced, and a study of the excretion patterns suggests predominance of hormone mechanisms (ADH and aldosterone) probably activated by volume regulatory or osmoregulatory stimuli. The rise in GFR and RPF may be caused by reduction of blood viscosity combined with a rise in arterial blood pressure. A reflex vasodilatation of renal vessels may tentatively be attributed to a rise in central venous pressure. (Contractor's abstract)

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Free U. of West Berlin (Germany).

CIRCULATORY BASIS OF FLUID VOLUME CONTROL, by O. H. Gauer and J. P. Henry. [1962] [59]p. incl. illus. tables, refs. (AF 61(052)31) Unclassified

Published in Physiol. Rev., v. 43: 423-481, July 1963.

The status of the high-pressure or arterial system is primarily determined by the regulation of cardiac output and the tone of the resistance vessels. It is proposed that corresponding parameters for the low-pressure system are the blood volume and the tone of the capacitance vessels, which together determine the "fullness of the blood stream." The fullness of the blood stream is an important determinant of cardiac performance. The concept is also advanced that volume regulation is an integral part of over-all cardiovascular regulation, the latter of which has hitherto been primarily considered with regard to adjustments of pressor or depressor activity affecting the heart and vascular wall tension. The control of the 2 systems seems to depend on the total sensory input from receptors in both low- and high-pressure regions. Evidence is presented which suggests that this input may be integrated into information describing the performance of the heart in relation to the load imposed on it ("competence" of the heart). In the case of the low-pressure system the adjustment of the contained volume is

of greater importance for homeostasis than the adjustment of capacity. The latter appears to have an emergency function. Volume regulatory activity has been judged from changes of mineral and water excretion by the kidney. It is concluded that the controls of water and mineral excretion are relatively indpendent, and that the system responsible for the regulation of water excretion are more sensitive and react faster than do those concerned with minerals. The equally important parameters of regulation of plasma proteins and blood cell volume have not been considered.

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Free U. of West Berlin (Germany).

SPHERICALLY SYMMETRIC MODELS IN RELATIVISTIC AND NEWTONIAN COSMOLOGY, by K. Just and K. Kraus. [1962] [10½p. incl. refs. (AFOSR-3926) (AF 61(052)335) Unclassified

Also published in Zeitschr. Astrophys., v. 55: 127-136, June 1962.

The spherically symmetric solutions of Einstein's equation for an ideal fluid without pressure, having been found by several authors, are discussed. Special emphasis is laid on the specification of a particular model by initial conditions with an immediate meaning. The use of those local solutions for constructing global models with or without spherical symmetry is subject to interesting restrictions. These have practical importance for an inhomogeneous model, supposed to represent the universe somewhat better than Friedmann's homogeneous models. Here the new condition requires a density depression around each big cluster of galaxies. This however is very plausible, if one assumes the clusters to have concentrated from a homogeneous distribution; and it seems not to contradict the observations. The obvious defects of this treatment, that the cluster models are exactly spherical and must not rotate or overlap, cannot be removed so easily. But the most serious neglect seems to be that of pressure, thus it will be necessary to try to account for this at least approximately. It is shown that apart from its inherent incompleteness the Newtonian cosmology yields exactly the same local solutions, while the global models lead to questions of topology.

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Free U. of West Berlin (Germany).

SPHERICALLY SYMMETRIC MODELS IN RELATIVISTIC AND NEWTONIAN COSMOLOGY, by K. Just and K. Kraus. [1962] [10½p. incl. refs. (AFOSR-4111) (AF 61(052)335) Unclassified

Also published in Zeitschr. Astrophys., v. 55: 127-136, June 1962.

For abstract see item no. 944, Vol. VI.

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Free U. of West Berlin (Germany).

THEORETICAL RESEARCH STUDIES BY REACTING PLASMAS, by G. Ludwig. Final rept. July 31, 1962, 3p. (AFOSR-3537) (AF EOAR-61-48) AD 460156 Unclassified

The purpose of this paper was to adapt macroscopical equations for describing plasmas, starting from classical mechanics. This was achieved in the following ways: (1) Macroscopical Markovian flows in Γ -space were considered and the transition probabilities of the master equation, which holds for macroscopical Markovian flows, for the special case of a dilute gas were calculated; (2) Macroscopical determinated flows in Γ-space were considered and the Boltzmann-equation, a derivation of which was previously given, was generalized by taking into account collisions of the third order; and (3) Supposing some generalized Boltzmann equations, which are derived by intuitive methods and which describe a 2 component reacting system, the equations of motion for some macroscopical observables of interest were calculated. The basic Boltzmann equations are formulated by means of the multi-channel formalism of the classical mechanics.

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Free U. of West Berlin (Germany).

THE HYDRODYNAMIC EQUATIONS FOR DI-ATOMIC-EXCITED AND DISSOCIATED GASES AS APPROXIMATIONS OF THE BOLTZMANN EQUATIONS DESCRIBING SUCH GASES. PART I, by G. Ludwig. Nov. 15, 1962, 46p. incl. refs. (Technical rept. no. 5) (AFOSR-459C) (AF EOAR-61-48) AD 401375 Unclassified

Boltzmann equations for diatomic, excited and dissociated gases were treated by a generalized GRAD method to gain macroscopical transport equations which correspond to the Navier-Stokes equations. Neither chemical equilibrium nor equilibrium between the internal translational degrees of freedom is assumed. The connection between the wanted coefficients of viscosity and heat conduction and certain collision-integrals is given explicitly. (Contractor's abstract)

948

Galway U. Dept. of Chemistry (Ireland).

SPECTROPHOTOMETRIC STUDIES OF SOME RED ALGAL CONSTITUENTS, by C. ÓhEocha. [1960] [14]p. incl. diagrs. table, refs. (AFOSR-2622) (AF 61(052)-409) Unclassified

Also published in Chimie et Physioco-chimie des Principes Immédiats tirés des Algues, Dinard (France) (Sept. 20-25, 1960), Paris, Centre National de la Recherche Scientifique, 1961, p. 121-134.

The fluorescent substances which have been described are added to the list of unusual products of red algal, particularly Rhodomelacean, metabolism. However, much further work will be required before they are fully characterized. That their distribution may be of taxonomic significance is indicated by the striking correlation between UV spectra of extracts and the accepted generic grouping of the Rhodomelaceae examined. However, because of their lability and the seasonal variation in their abundance, taxonomic inferences based on the distribution of these compounds must await a more detailed study. Similar caution applies to many other constituents of the red algae which undergo seasonal variation, e.g. peptides and brominated phenols. Nevertheless, results to date, including Yaphe's survey of red algal polysaccharides, indicate the potential usefulness of a thorough chemical survey of the red algae as an aid in their classification.

949

Galway U. Dept. of Chemistry (Ireland).

ZINC COMPLEX SALT FORMATION BY BILIRUBIN AND MESOBILIRUBIN, by P. O'Carra. [1962] [3]p. incl. diagr. (AFOSR-2911) (AF 61(052)409) AD 405539 Unclassified

Also published in Nature, v. 195: 899-900, Sept. 1, 1962.

It is generally accepted that rubins do not form zinc complexes since most bile pigments form brilliantly florescent zinc salts and the rubins did not fluoresce. Evidence is presented that addition of 2% methanolic zinc acetate to bilirubin changed the color from yellow (absorption max, 452 mμ) to saffron, (absorption max, 476 mμ), this process was reversible. Similar results were obtained with mesobilirubin. Since only acid-reversible reaction of the zinc ions with the rubins could be responsible for the spectral shifts (control experiments having shown that the acetate ions were not), this evidence indicates that bilirubin and mesobilirubin form nonfluorescent zinc complexes.

950

Galway U. Dept. of Chemistry (Ireland).

METHIONE, THE N-TERMINAL AMINO-ACID OF PHYCOERYTHRINS, by P. O'Carra and C. ÓhEocha. [1962] [2]p. (AFOSR-4188) (AF 61(052)409) Unclassified

Also published in Nature, v. 195: 173-174, July 14, 1962.

Methionine was the N-terminal amino acid of phycoerythrins from 3 different marine algae. This conclusion was based on paper chromatography of diluted hydrolyzates of the dinitrophenyl phycoerythrins and of the free amino acid obtained by the alkaline hydrolysis of the dinitrophenyl derivations.

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Galway U. Dept. of Chemistry (Ireland).

THE PHYCOBILINS, by C. ÓhEocha. [1962] [1]p. (AFOSR-4244) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)409 and National Science Foundation) Unclassified

Presented at 419th meeting of the Biochem. Soc., Inst of Rural Science, Penglais, Aberystwyth (Wales), Sept. 13-14, 1962.

Also published in Biochem. Jour., v. 85: 2P-3P, Nov 1962.

HCl (12N) is required to effect a release of protein-free pigment from C-phycocyanin, although the protein is readily denatured with loss of fluorescence by EtOH, urea, and acid. The difference spectrum of C-phycocyanin denatured with EtOH at pH 2.7 and 8.0 is identical with that of phycobilin 630 in the same solutions indicating that the prosthetic group of the biliprotein is phycobilin 630. Heating for 20 min in concentrated HCl, or standing for 7 hr in 12N HCl at 25° converts phycobilin 630 to a pigment having spectral properties similar to those of mesobiliviolin. On standing in 9-11N HCl, phycobilin 630 is converted to a pigment termed phycobilin 655, different in properties from mesobiliviolin. This pigment was also isolated from 12N HCl hydrolyzate of C-phycocyanin neutralized berore extraction into organic solvents. The difference spectrum of this pigment at pH 2.7 and 8.0 shows a max at 675 mμ compared with 658 mμ for phycobilin 630 and denatured C-phycobilin. Phycobilin 655 is dibasic with its diprotonated form dissociating with a pK of 3.5 and its monoprotonated form with a pK of 5.7. It is suggested that phycobilin 630 is hydrated on the vinyl side chains. R-phycoerythrin contains 2 dissimilar phycobilins, one of which is released by acid. The resulting phycoerythrobilin is a rhodinoid bile pigment isomerized by acid to a labile urobilin which forms unhydrolyzable linkages with compounds containing -SH groups in the protein of phycoerythrin. Ethyl mercaptan competes with the protein-SH groups.

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Galway U. Dept. of Chemistry (Ireland).

PHYCOBILINS, by C. ÓhEocha. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-J702) (AF 61(052)409) AD 413637 Unclassified

Also published in Physiology and Biochemistry of Algae, ed. by R. A. Lewin. New York, Academic Press, 1962, p. 421-435.

Photosynthetically active red and blue biliproteins, called phycoerythrins and phycocyanins, respectively, have been isolated only from algae. Their prosthetic groups or chromophores are tetrapyrroles known as phycobilins. Unlike the chlorophylls, phycobilins are not readily released from associated proteins; hence biliproteins have been most generally studied. In this review, emphasis is placed on recent works. The study is in 5 parts: (1) Distribution and formation of the phycobilin-proteins (biliproteins), (2) Isolation and purification of the biliproteins, (3) Physical properties of the biliproteins, (4) Amino-acid composition of the proteins, (5) Preparation and properties of the phycobilins, and (6) Phycobilin-protein linkages.

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Galway U. [Dept. of Chemistry] (Ireland).

THE STRUCTURE OF THE PHYCOBILINS, by C. OhEocha. Final rept. Sept. 29, 1962, 48p. incl. diagrs. tables, refs. (AF 61(052)409) AD 292679 Unclassified

The literature concerned with the chemistry of algal biliproteins is surveyed. Amino acid analyses of carefully purified samples of R- and C-phycoerythrin and of C-phycocyanin were performed. All 3 are characterized by a high percentage of dibasic and of hydrophobic amino acids. R-, B- and C-phycoerythrins were found to contain methionine as their N-terminal amino acid residue. A proteolytic enzyme preparation was obtained from the blue-green alga Phormidium persicinum. The phycoerythrobilin prosthetic group of R-phycoerythrin was purified and some of its physical and chemical properties determined. The urobilin obtained on isomerization of phycoerythrobilin in concentrated hydrochloric acid was studied, and a number of useful derivatives prepared. It was shown that 12N HCl is required to liberate the native prosthetic group of C-phycocyanin. Two other closely related pigments were isolated from this biliprotein and their physical and chemical properties studied. R-phycocyanin was shown to be a homogeneous chromoprotein containing subunits characteristic of phycoerythrin and of C-phycocyanin. (Contractor's abstract)

954

General Applied Science Labs., Inc., Westbury, N. Y.

ACOUSTIC FIELD OF A CYLINDRICAL JET DUE TO A DISTRIBUTION OF RANDOM SOURCES OR QUADRUPOLES, by S. Slutsky. Feb. 1962, 58p. incl. diagrs. (Technical rept. no. 281) (AFOSR-2455) (AF 49(638)-194) AD 276032 Unclassified

A method is used to describe the field of a single harmonic oscillator to the description of the far field of a random distribution of sources and quadrupoles arising in an axisymmetric steady flow field. The random source distribution is described in terms of a spatial and temporal correlation function. Expressions are obtained for the mean square intensity and power spectral density of the acoustic noise field. The effect of eddy convection is not included. It is found that the assumption of a source mechanism results in a far field distribution which resembles those experimentally available, whereas the lateral quadrupole mechanism fails in this respect. (Contractor's abstract)

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General Applied Science Labs., Inc., Westbury, N. Y.

LINEARIZED FREE-MIXING WITH PRESSURE GRADIENT, by M. H. Steiger and M. H. Bloom. Apr. 1962, 26p. incl. diagrs. refs. (Technical rept. no. 285) (AFOSR-2613) (AF 49(638)991) Unclassified

The velocity fields of compressible 2-dimensional and incompressible axisymmetric viscous free-mixing regions with streamwise pressure gradients are examined with the use of the boundary layer approximations and Oseen's linearization of the convective terms. Solutions are derived for both wake-like flows (that is, velocities within the viscous region less than those in the external free stream), and jet-like flows (wherein the velocities in the viscous region are greater than those in the external free stream). In compressible cases, the energy equation admits a Crocco integral when the Lewis and Prandtl numbers are equal to unity, and a similar integral of the concentration equation is derived for $Le/\sigma = 1$ and $W_i \to 0$. However, only the condition of uniform stagnation enthalpy and an approximate equation of state (relating density to enthalpy) is utilized in the analysis. It is shown that the solution, for both 2-dimensional and axially symmetric flow, produces an infinite continuous set of eigenvalues and associated eigenfunctions that satisfy the appropriate boundary conditions at the axis and infinity. This is consistent with the fact that a solution is unique only if an initial distribution or eigenvalue is prescribed a priori. For completeness, only solutions that behave exponentially at large n are admitted and these results are discussed. (Contractor's abstract)

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General Applied Science Labs., Inc., Westbury, N. Y.

APPROXIMATE ANALYSIS OF THE SLOT INJECTION OF A GAS IN LAMINAR FLOW, by P. A. Libby and J. A. Schetz. [1962] [6]p. incl. diagrs. refs. (AF 49-(638)991) Unclassified

Published in AIAA Jour., v. 1: 1056-1061, May 1963.

The laminar diffusion and combustion of a gas injected into a high-speed uniform stream by means of a wall slot are considered. The Dorodnitzin-Howarth transformation is employed to reduce the boundary layer equations to incompressible form; the nonsimilar flow field is treated by a modified Oseen approximation in conjunction with the integral method. Thermal boundary conditions corresponding to an adiabatic wall and to constant wall enthalpy are discussed. The injection of homogeneous, heterogeneous, nonreactive, and reactive gases is treated. For the latter case, the models usually employed for chemical behavior, namely, frozen and equilibrium flow, are considered. The analysis is applicable to a wide variety of laminar flows, e.g., those

involving cooling, thermal protection, skin-friction reduction, and supersonic deflagration. A numerical example of practical interest in connection with the venting of gaseous hydrogen boiloff from a rocket booster is presented. (Contractor's abstract)

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General Applied Science Labs., Inc., [Westbury] N. Y.

EXPERIMENTAL RESULTS ON SUPERSONIC COMBUSTION, by J. Tamagno and O. Lindemann. Dec. 1962, 35p. incl. illus. diagrs. (Technical rept. no. 322) (AF 49(638)991) AD 294809 Unclassified

Experiments on spontaneous combustion characteristics of hydrogen injected into a supersonic stream of hot air are described in detail. The results are presented and compared with a theory developed for premixed reactants. The experimental data show that if the initial static temperature and the static pressure of the air stream are high enough then diffusion will be rate controlling and a mixing theory using equilibrium chemistry could be used in analyzing the combustion process. If the chemical reactions are slow, the behavior of the combustion process can be studied as a system where mixing and diffusive effects are absent. The ignition delay times inferred from the initiation of the pressure rise along the burner are in good agreement with those predicted by the empirical correlation. The static temperature exerts a greater influence on the ignition delay time than the static pressure. The static pressure level is an important parameter in determining the time for complete combustion. (Contractor's abstract)

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General Dynamics Corp. [Convair Div.] San Diego, Calif.

LOW-ENERGY GAMMA RAYS PRODUCED IN AIR AND IN LEAD BY COSMIC RAYS, by J. I. Vette. [1962] [8]p. incl. diagrs. tables, refs. (AF 49(638)561) Unclassified

Published in Jour. Geophys. Research, v. 67: 1731-1739, May 1962.

Measurements have been made at 40.5°N geomagnetic latitude of γ rays produced in lead and in air within the energy range 25-1060 kev up to altitudes of 5.4 g/cm^2 by means of balloon-borne scintillation counters. The γ rays of atmospheric origin exhibit a transition curve that peaks at 70 g/cm^2 and is similar to transition curves measured with other omnidirectional detectors. The measurements give a flux of 17.3 photons/cm^2/sec at the peak of the transition curve; extrapolation to the top of the atmosphere gives an albedo of 5.7 photons/cm^2/sec. The spectra of the photons produced in lead and in air are very similar, and the production per gram of lead is found to be about 2.7 times that per gram of air. The power contained in γ rays up to 1 mev is estimated to be 7% of the incoming power from primary cosmic rays. Because of this large intensity the origin of the photons is difficult to explain in terms of the nucleonic component but is compatible with an explanation based on an electromagnetic origin.

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General Dynamics Corp. [Convair Div.] Pomona, Calif.

A TWO DIMENSIONAL ANALYSIS OF ELASTIC THERMAL STRESS WITH APPLICATION TO ROCKET MOTOR GRAINS, by R. G. Shook. Sept. 21, 1962, 22p. incl. diagrs. tables. (AFOSR-3880) (AF 49(638)592) Unclassified

The problem considered is that of obtaining the thermal stresses due to a radial temperature distribution in a circular plate containing a central star-shaped perforation. The complex analysis of Muskhelishvili is employed to obtain this solution. In order to apply the boundary conditions, use is made of conformal mapping. Series solutions are obtained and these are compared with experimental results. (Contractor's abstract, modified)

960

General Dynamics Corp. General Atomic Div., San Diego, Calif.

CHEMICAL REACTIONS USING MODULATED FREE RADICAL BEAMS. PART A. THE VAPOR PRESSURE OF SOLID HYDROGEN IN THE TEMPERATURE RANGE FROM 4.7K TO 11.1K. PART B, by H. Harrison, W. L. Fite, and G. L. Guthrie. Final rept. Feb. 1, 1961 - Jan. 31, 1962. Feb. 28, 1962 [62]p. incl. diagrs. tables, refs. (Rept. no. GA-2972) (AFOSR-2357) (AF 49(638)301) AD 277010 Unclassified

Modulated, crossed molecular beams were employed to study the chemical kinetics of several free-radical reactions. For the hydrogen-isotope exchange ($H + D^2 \rightarrow HD + D$) signals were detected which correspond to a reaction cross-section of $\sim 10^{-19}$ cm^2. Elastic scattering complicates the interpretation. The promises, methods, and difficulties of the crossed-beam technique are discussed. Measurements were made of the vapor pressure of solid H, of a nominal 75% orthohydrogen composition, from 4.7° to 11.1°K. The results were fitted to Kirchoff's equation. A suitable expression for the vapor pressure was found to be $\log P_{(mm)} = -43.39/T + 5/2_{\log}$, $T(°K) + 2.047$ from 4.7 to 13.95°K.

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General Dynamics Corp. General Atomic Div., San Diego, Calif.

TOTAL COLLISION CROSS SECTIONS FOR SCATTERING OF THERMAL BEAMS OF HYDROGEN, HYDROGEN ATOMS, AND HELIUM BY HYDROGEN AND HELIUM, by H. Harrison. [1962] [2]p. incl. diagr. refs. [AF 49-(638)301] Unclassified

Published in Jour. Chem. Phys., v. 37: 1164-1165, Sept. 1, 1962.

Experiments for measuring the total collision cross sections for interactions of hydrogen atoms, helium, and hydrogen molecules with hydrogen and helium are described. Results show less velocity dependence than predicted by the Massey-Mohr equation.

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General Dynamics Corp. General Atomic Div., San Diego, Calif.

REFLECTION AND DISSOCIATION OF H_2 ON TUNGSTEN, by J. N. Smith, Jr., and W. L. Fite. [1962] [7]p. incl. diagrs. refs. (AFOSR-2611) (AF 49(638)-356) AD 276645 Unclassified

Also published in Jour. Chem. Phys., v. 37: 898-904, Aug. 15, 1962.

Through the use of modulated atomic beam techniques, the reflection and dissociation of H_2 at a W surface above 2500°K was studied. Two experimental configurations were employed. In the first configuration, a collimated beam of molecular hydrogen was directed at the W surface, and the angular distribution of particles evaporating from the surface was examined mass-spectrometrically. In the second configuration, the W test surface was located in the first of 3 differentially pumped vacuum chambers. H_2 was admitted into this chamber thereby providing an isotropic source of incident particles. Particles evaporating from the surface were collimated and examined mass-spectrometrically in the third chamber. From these experiments it is observed that at high temperatures the angular distribution of atomic hydrogen evaporating from the target surface obeys the cosine law. However, the angular distribution of reflected H_2 displays a shift toward the specular ray. Above 2500°K the sticking probability of H_2 on W approaches a limiting value of 0.3. (Contractor's abstract)

963

General Dynamics Corp. General Atomic Div., San Diego, Calif.

INTERACTION OF ATOMS WITH SURFACES, by J. N. Smith, Jr. and W. L. Fite. Final rept. Apr. 1, 1958 - Sept. 30, 1962. Nov. 6, 1962, 11p. (Rept. no. GA-3615) (AFOSR-411C) (AF 49(638)356) AD 292963 Unclassified

Experimental modulated atomic beam techniques, adapted for the study of gas-surface interactions, are summarized. The scope and purpose of research conducted, using these techniques, are outlined. Several types of interactions between molecules and atoms at thermal velocities and solid surfaces are discussed. In particular, the dissociation of H_2 on W, the scattering of H_2 on Ni, and the chemical reaction between Cl_2 and Ni are mentioned. Various other experimental observations and measurements are catalogued. (Contractor's abstract)

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General Dynamics Corp. General Atomic Div., San Diego, Calif.

RECENT INVESTIGATIONS OF GAS-SURFACE INTERACTIONS USING MODULATED-ATOMIC-BEAM TECHNIQUES, by J. N. Smith, Jr. and W. L. Fite. [1962] [24]p. incl. diagrs. (AFOSR-J1044) (AF 49(638)356) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 1: 420-453, 1963. (AFOSR-5310)

This research was directed toward gaining a more complete knowledge of the effect of the interaction between individual gas particles and the surfaces of space vehicles on the aerodynamics of the upper atmosphere. The first experiment discussed is that of the scattering of molecular hydrogen by polycrystalline Ni. It was found that with certain specific pretreatments, near specular scattering of the incident H_2 beam was obtained. In addition, an angular variation in the thermal-accommodation coefficient was observed. In the second experiment, the reflection and dissociation of hydrogen on W at high temperatures were examined. Near specular scattering of the incident H_2 was found at W temperatures above 1800°K. The angular distribution of H_2 evaporating from the target followed the cosine law, indicative of diffuse emission. Above 2500°K, the sticking probability for H_2 on W was found to be temperature-independent at a value of 0.3. The last experiment discussed involved the reaction of Cl_2 and Ni to form Ni chlorides. The reaction products NiCl and $NiCl_2$ were observed. Of particular interest is the fact that phase-sensitive detection of the ac signals permits measurement of the reaction-residence time for the formation of NiCl. (Contractor's abstract)

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[General Electric Co. Flight Propulsion Div., Cincinnati, Ohio]

PROCEEDINGS OF THE THIRD SYMPOSIUM ON ADVANCED PROPULSION CONCEPTS, VOL. I, Cincinnati, Ohio, Oct. 2-4, 1962, New York, Gordon and Breach Science Publishers, 1963, 432p. incl. illus. diagrs. tables, refs. (AFOSR-3898, v. 1) [AF 49(638)1193] Unclassified

Volume I, of two volumes comprising the proceedings of this symposium, consists of a collection of papers concerning recent theoretical and experimental investigations of advanced spacecraft propulsion concepts. Subjects covered are: studies of ion and electrothermal propulsion; plasma propulsion, including impulsive MHD devices and plasma acceleration by a traveling

magnetic field; electrostatic acceleration of neutral plasmas, including momentum transfer through magnetic and electric fields; thermionic and turbonuclear space power systems; and nuclear fission and fusion propulsion concepts.

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[General Electric Co. Flight Propulsion Div., Cincinnati, Ohio].

PROCEEDINGS OF THE THIRD SYMPOSIUM ON ADVANCED PROPULSION CONCEPTS, VOL. II, Cincinnati, Ohio, Oct. 2-4, 1962 (Unclassified), New York, Gordon and Breach Science Publishers, 1963, 289p. incl. illus. diagrs. tables, refs. (AFOSR-3898, v. 2) [AF 49(638)1193] AD 349406 Confidential

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

DIRECT OBSERVATION OF INDIVIDUAL ADATOMS: NITROGEN ON TUNGSTEN, by G. Ehrlich and F. G. Hudda. [1962] [13]p. incl. illus. diagrs. refs. (AFOSR-2601) (AF 49(638)791) AD 435179 Unclassified

Also published in Jour. Chem. Phys., v. 36: 3233-3247, June 15, 1962.

The utility of the field ion microscope for adsorption studies has been explored by examining the interaction of nitrogen with an atomically smooth tungsten surface. Individual nitrogen adatoms are shown to be visible, and it is demonstrated that adsorption fails to perturb the lattice permanently. In probing the room-temperature distribution of adsorbed material, the closely packed (110) is found to remain bare, even when exposed to nitrogen at $p = 2 \times 10^{-3}$ mm for 2 hr. All the other planes, with the possible exception of the {100} and {130}, are irreversibly covered. Nitrogen, presumably in the form of atoms, is bound on the (110) only at $T < 190°K$. Adsorption on this plane at higher temperatures is limited not by an activation barrier but rather by thermodynamics: the binding energy on the (110) is only 5.1 ev, compared with 6.7 ev elsewhere on the surface. (Contractor's abstract)

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

TRAPPING AND ENERGY TRANSFER IN ATOMIC COLLISIONS WITH A CRYSTAL SURFACE, by B. McCarroll and G. Ehrlich. [1962] [10]p. incl. diagrs. refs. (AFOSR-J346) (AF 49(638)791) AD 435180 Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 555, Nov. 23, 1962.

Also published in Jour. Chem. Phys., v. 38: 523-532, Jan. 15, 1963.

The condensation of atoms on a solid is examined by calculating the critical energy for trapping of a particle of arbitrary mass and force constant colliding with a linear lattice. In the harmonic approximation and using classical mechanics, the maximum kinetic energy for trapping is found to depend strongly upon the well depth, in qualitative agreement with experiment.

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[General Electric Co.] General Electric Research Lab., Schenectady, N. Y.

MOLECULAR PROCESSES IN ADSORPTION OF METALS, by G. Ehrlich [1961] [20]p. incl. illus. diagrs. tables, refs. (AFOSR-64-0484) [AF 49(638)791] AD 435177 Unclassified

Also published in 1961 Trans. Eighth Nat'l. Vacuum Symposium combined with Second Internat'l. Cong. on Vacuum Science and Technology, Washington, D. C. (Oct. 16-19, 1961), ed. by L. E. Preuss. New York, Pergamon Press, v. 1: 126-145, 1962.

The macroscopic kinetics and energetics of the elementary atomic processes occurring on metal surfaces are examined experimentally. More complicated events, such as adsorption and evaporation of molecules, as well as molecular dissociation and reconstitution, are then analyzed using the empirical information available on atomic events. The dependence of molecular interactions upon the detailed atomic structure of metal surfaces, as well as the presence of multiple binding states, are finally presented, as revealed by flash desorption and field ion microscopy. (Contractor's abstract)

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

ADSORPTION AND ELECTRICAL CONDUCTION IN THIN FILMS, by G. Ehrlich. [1961] [3]p. incl. refs. (AFOSR-64-0485) (AF 49(638)791) AD 435176 Unclassified

Also published in Jour. Chem. Phys., v. 35: 2165-2167, Dec. 1961.

For abstract see item no. 859, Vol. V.

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

THE FERMI SURFACES OF METALS, by W. A. Harrison and R. W. Schmitt. [1961] [6]p. incl. illus. diagrs. (AF 49(638)926) Unclassified

Also published in Phys. Today, v. 14: 20-25, Feb. 1961.

This is a report on an international conference on the electronic structure of metals. The bulk of the conference consisted of reports of various experimental studies of metallic Fermi surfaces. Some of the methods discussed are: the de Haas-van Alphen effect, the magnetoacoustic effect, the cyclotron resonance, anomalous skin effect, and magnetoresistance.

972

General Electric Co. [General Electric Research Lab.] Schenectady, N. Y.

ON THE ATOMIZATION AND ENTRAINMENT OF LIQUID FILMS IN SHEAR FLOW, by N. Zuber. Sept. 1962 [53]p. incl. diagrs. refs. (AFOSR-3989) (Rept. no. 62GL153) (AF 49(638)1153) Unclassified

The concept of critical boundary shear is used to describe the conditions leading to the destruction of a liquid film by high velocity gases flowing through a duct. From this concept, several similarity criteria are derived for predicting the onset of film destruction and of drop entrainment as function of the flow conditions in both phases. The transition in the 2-phase flow regimes (from annular film flow to droplet flow) predicted by these similarity criteria are shown to be in satisfactory agreement with experimental data available in the literature. Some similarity criteria for separators of special geometries are presented also. The significance of the results to the problem of film cooling of rocket engines and to the burnout problem in nuclear reactors is discussed. (Contractor's abstract)

973

General Electric Co. [General Electric Research Lab.] Schenectady, N. Y.

STEADY STATE AND TRANSIENT VOID FRACTION OF BUBBLING SYSTEMS AND THEIR OPERATING LIMITS, PART II: TRANSIENT RESPONSE, by N. Zuber and J. Hench. July 1962 [44]p. incl. diagrs. (Rept. no. 62GL111) (AFOSR-3990) (AF 49(638)1153) Unclassified

The result of an analytical and experimental investigation of the transient response of a 2-phase (bubbling) flow system are reported. Good agreement of predicted values with experimental results is shown. The theory of kinematic (continuity) waves is used to analyze transients in 2-phase systems. It is shown that changes in the vapor (void fraction) are propagated through the 2-phase mixture by kinematic waves. Kinematic shock waves are used to analyze the propagation of large discontinuities of vapor concentration. The results show that the transient response of a 2-phase mixture depends upon the flow regimes. The characteristics of the response can change completely, when a change in the 2-phase flow regimes occurs. The effect of kinematics (continuity) waves on the changes of the 2-phase flow regimes is discussed. The analysis indicates that, in a 2-phase flow system, a diffusion by the kinematic wave process takes place. The diffusion coefficient for this process can be determined from the kinematic wave theory. The significance of the results presented in this paper to nuclear technology, reactor kinetics and chemical process systems is noted. (Contractor's abstract)

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

ANALYTICAL ASPECTS OF APPLIED CELESTIAL MECHANICS (Abstract), by V. G. Szebehely. [1961] [1]p. (AFOSR-3695) (AF 49(638)814) Unclassified

The central problem of celestial mechanics is to find the general solution of the differential equations describing the motion of bodies in a gravitational field. This problem is readily solved for 2 bodies moving in the field created by their mutual gravitational attraction. When the number of bodies is increased, the solution can not be represented in closed form. The reasons for the involvability are discussed along with questions of existence of the solution. A critical review is presented of new and old techniques to obtain particular solutions of particular problems for limited ranges of the variables involved. Power and Fourier series solutions, regularization, special and general perturbation, known integrals, Cauchy's Poincare's, Brun's and Mineur's theorems are discussed. It is shown that orbit and trajectory determination related to space travel, a field often called applied celestial mechanics, space mechanics or astrodynamics faces the same basic difficulties as classical celestial mechanics. Some new problems, emerging as the result of recent emphasis on space exploration are discussed and promising areas of future research are indicated.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

PROBLEMS ON APPLIED CELESTIAL MECHANICS (Abstract), by V. G. Szebehely. [1961] [1]p. (AFOSR-3696) (AF 49(638)814) Unclassified

Celestial mechanics deals with the determination of the motion of celestial bodies and until recently only members of the solar system were of interest. The 2 directions in which celestial mechanics is expanding are: (1) study of the motion of artificial satellites, planetoids and other space probes in force fields not purely gravitational including drag and radiation pressure effects and (2) an investigation of the dynamics of bodies outside the solar system such as the determination of the density distribution of binary stars. The first item, often referred to as applied celestial mechanics, space mechanics or astrodynamics, is the subject of this research. The central problem of astrodynamics is introduced via the celebrated 3-body problem, and its insolvability is discussed. Several special problems of great interest awaiting solution are described such as the 2 point boundary value problem of interplanetary missions, stability of motion near libration points in the Earth-Moon system, possibility of establishing

permanent Earth-Moon satellites, stability of lunar satellite motion, utilization of solar radiation pressure, etc. The problem of Earth-Venus trajectories is treated in detail.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

REVIEW OF APPLIED CELESTIAL MECHANICS (Abstract), by V. G. Szebehely. [1961] [1]p. (AFOSR-3697) (AF 49(638)814) Unclassified

A systematic review is presented of the field which is often referred to as space trajectories, space mechanics, astrodynamics or applied celestial mechanics. The major aim of this scientific discipline is to find the general solution of the problem of the motion of bodies in a gravitational field. Inasmuch as this general problem possesses no general solution, the review of the multitude of special problems is organized according to their application to space research engineering. The first major problem group is termed orbit and trajectory determination. Solution is based on celstial mechanics utilizing powerful modern numerical techniques and computer technology. The second major group is termed guidance which is discussed in its most general aspects as the inverse of the first problem. A critical review of recent significant advances in space mechanics emphasizes the necessity of familiarity with the results and techniques of classical celestial mechanics. Without this knowledge, an avalanche of re-inventions and poor modifications of well established results are presently being reproduced. The lecture is concluded with references to geographical centers of technical compitance in astrodynamics, to the few important publications and to some problems currently considered as urgent, significant and yet unsolved.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

RENAISSANCE OF CELESTIAL MECHANICS-SPACE MECHANICS (Abstract), by V. G. Szebehely. [1961] [1]p. (AFOSR-3698) (AF 49(638)814) Unclassified

The 3 major objectives of space mechanics are orbit determination from observations, trajectory calculation, and guidance analysis. The 3 major missions of space exploration are earth satellites, lunar research vehicles, and interplanetary space probes. The 9 elements of the 3 x 3 matrix defined by the 3 missions and 3 objectives will be discussed with examples. The most significant advances, the present state of the art, the unsolved problems, future expectations, and the contributions of classical celestial mechanics, engineering, and numerical analysis will be outlined. The proper weight assigned to these fields of scientific endeavor is shown to be the key to the progress in space mechanics, often referred to as astrodynamics of applied celestial mechanics; the last name indicating the important role played by this classical science in modern space research. Earth-Venus trajectories, with the aid of a motion picture, will be discussed in some detail.

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General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

ASTRODYNAMICS, by V. G. Szebehely. [1962] [4]p. incl. illus. refs. (AFOSR-4322) (AF 49(638)814) Unclassified

Also published in Astronautics, v. 7: 52-55, Nov. 1962.

Brief consideration of the state-of-the-art of astrodynamics, including detailed discussion of orbit prediction, determination and modification is presented. Literature in the field is reviewed, and leading periodicals, recently published books, and volumes of papers presented at national and international meetings are listed.

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General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

ARE ZERO VELOCITY CURVES ORBITS? by V. G. Szebehely. [1962] [2]p. (AFOSR-J188) (AF 49(638)-814) AD 400175 Unclassified

Also published in ARS Jour., v. 32: 1938-1939, Dec. 1962.

In general, zero velocity curves are not orbits. Requirements on the initial conditions and on the field are given which, if satisfied, render affirmative answers. A number of results are discussed relating the zero velocity curves to orbits and specifically to periodic orbits. (Contractor's abstract, modified)

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General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

ZERO VELOCITY CURVES AND ORBITS IN THE RESTRICTED PROBLEM OF THREE BODIES, by V. G. Szebehely. [1962] [5]p. (AFOSR-J763) (AF 49(638)814) AD 413885 Unclassified

Also published in Astronom. Jour., v. 68: 147-151, Apr. 1963.

Relations between zero velocity curves and orbits are investigated for the restricted problem of 3 bodies. A condition which the force function must satisfy is derived, giving a criterion for identifying certain periodic orbits with zero velocity curves. This general result is applied to the limiting case of the problem ($\mu = 0$), and to case of "small" μ, i.e., when terms of the order of μ^2 are neglected. It is shown that, in the latter case, perturbations of the order of r^2 for the satellite motion ($r << 1$) and of the order of r^{-3} for the planetary case ($r >> 1$) limit the applicability of the general results. (Contractor's abstract)

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

END LOSSES IN MAGNETOHYDRODYNAMIC CHANNELS WITH TENSOR ELECTRICAL CONDUCTIVITY AND SEGMENTED ELECTRODES, by G. W. Sutton. Mar. 1962 [33]p. incl. diagrs. (Rept. no. R62SD35) (AFOSR-3897) (AF 49(638)914) AD 277257 Unclassified

Also published in Jour. Appl. Phys., v. 34: 396-403, Feb. 1963.

End losses of an inviscid magnetohydrodynamic channel having tensor conductivity and segmented electrodes were calculated for a magnetohydrodynamic power generator of this geometry. It was found that the constant-current configuration is more efficient than the constant potential difference case. The efficiencies increase with increasing Hall effect, but constant magnitude extensions to the magnetic field have very little effect. The theoretical efficiency for an aspect ratio of 10 and $\omega\tau = 2$ is only 74%. (Contractor's abstract)

982

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THE THEORY OF MAGNETOHYDRODYNAMIC POWER GENERATORS, by G. W. Sutton. Dec. 1962, 205p. incl. diagrs. tables, refs. (Rept. no. R62SD990) (AFOSR-4635) (AF 49(638)914) AD 296430 Unclassified

The theory of magnetohydrodynamic power generators is presented. The topics covered are: electrical conductivity in MHD generators, optimum seed ratio, local analyses of the continuous and segmented electrode geometries; Hall geometry, helical flow geometry; magnetically induced ionization; polytropic efficiencies; compressible analyses of the constant velocity, temperature, Mach number, pressure and cross-sectional area flows; end losses; AC generation; cycle efficiencies; and a summary of experiments. Geometries other than linear are not considered herein; the most important of those omitted is the vortex generator. (Contractor's abstract)

983

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

EXACT SOLUTIONS FOR MAGNETOHYDRODYNAMIC CHANNEL FLOWS, by A. Sherman. Dec. 1962, 66p. incl. diagrs. refs. (Rept. no. R62SD991) (AFOSR-4638) (AF 49(638)914) AD 294378 Unclassified

Also published in Engineering Magnetohydrodynamics, by G. W. Sutton and A. Sherman, New York, McGraw-Hill, 1965, p. 340-388.

Simplified MHD Channel Flow problems for which exact solutions can be found are discussed. Both steady state and transient problems are considered, and account is taken of heat flux as well as velocity distributions. Secondary flows are also discussed. The bulk of the solutions are valid for arbitrary Magnetic Reynolds numbers, although some channel flows with non-uniform magnetic fields and small Magnetic Reynolds numbers are discussed. (Contractor's abstract)

984

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

ELECTRON CONDUCTIVITY AT CYCLOTRON RESONANCE, by D. J. BenDaniel, H. Hurwitz, Jr., and G. W. Sutton. [1962] [2]p. incl. diagrs. (AF 49(638)-914) Unclassified

Publishediin Phys. Fluids, v. 6: 884-885, June 1963.

The integral giving the component σ on the electron conductivity in the direction of the electric vector for e. m. radiation of circular frequency ω polarized in the right-handed sense, propagating along a uniform magnetic field, is evaluated, at finite temperatures, in the vicinity of cyclotron resonance for (1) isotropic monoenergetic electrons and (2) electrons with a Maxwell distribution of velocities. In both cases, as the collision frequency tends to zero, the real part of the conductivity approaches, at resonance, the value $\sigma_0 = ne^2V_{th}/\alpha$ km, where V_{th} is the thermal speed of the electrons, α is a number of order unity and the other symbols have their usual meaning. At resonance for a Maxwell distribution, σ is well approximated by the expression $1/\sigma = 1/\sigma_0 + 1/\sigma_{dc}$.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

HIGH ALTITUDE SHOCK WAVE STRUCTURE. PART I. SHOCK WAVE STRUCTURE WITH ROTATIONAL AND VIBRATIONAL RELAXATION. PART II. A SHOCK TUBE STUDY OF THE THERMAL DISSOCIATION OF NITROGEN, by S. M. Scala, L. Talbot, and B. B. Cary. Oct. 1962 [124]p. incl. illus. diagrs. tables, refs. (Rept. no. R62SD32) (AFOSR-2748) (AF 49(638)-931) AD 285619 Unclassified

A theoretical model is developed for the structure of a shock wave in a diatomic gas including rotational and vibrational relaxation phenomena. Experiments are carried out in a combustion driven shock tube. Experimental data for vibrational relaxation times and dissociation rates are obtained for nitrogen. Estimates are provided for the distribution of translational temperature through a normal shock wave obtained with the neglect of relaxation phenomena. Realistic values of the thickness of the shock transition also are obtained. Coupling between the internal degrees of freedom is investigated. Combustion generated shock is used for

shock structure studies. The relative efficiency of nitrogen atoms and molecules is determined. The data indicate that vibrational relaxation and dissociation may be treated in an uncoupled manner. Results were compared with the data obtained by earlier investigators.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

SHOCK WAVE STRUCTURE WITH ROTATIONAL AND VIBRATIONAL RELAXATION, by S. M. Scala and L. Talbot. [1962] [18]p. incl. diagrs. tables. (AFOSR-J1042) (AF 49(638)931) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press; Suppl. 2, v. 1: 297-314, 1963. (AFOSR-5310)

A new theoretical model for shock wave structure in a diatomic gas with rotational and vibrational excitations was developed, and numerical integrations have been carried out employing high speed electronic computing equipment. The model which is based on the use of symmetric relaxation equations yields results which seem reasonable for the full range of relaxation times and Mach numbers treated. More realistic estimates are provided for the distribution of translation temperature through a normal shock wave than would have been obtained with the neglect of relaxation phenomena. These results will be of use in further theoretical studies of the rates of chemical reactions (e.g., thermal dissociation) in strong shocks. The new calculations also give more realistic values for the effective thickness of the shock transition, which should yield better criteria for the determination of the condition of viscous merging at the nose of a blunt body in high altitude hypersonic flow.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

EXPERIMENTAL PLANETARY ENTRY RESEARCH FOR MARS AND VENUS - 1962, by T. K. Pygmire. Final rept. Oct. 1962 [164]p. incl. illus. diagrs. tables, refs. (TIS rept. no. R62SD84) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)931 and National Aeronautics and Space Administration) AD 400326 Unclassified

The program for planetary entry research for Mars and Venus was jointly coordinated between theoretical and experimental studies. The material reported is a final report of the 1962 experimental studies. The Martian and Venusian model atmospheres utilized, followed those given in a preliminary engineering estimate. As the characteristics of these atmospheres are not known precisely, probable bounds were established. These bounds for the Martian and Venusian atmospheres as well as the planetary dynamic data for the 2 planets are tabulated. As the Venusian atmosphere data was given in terms of temperature and pressure, the density was calculated and is plotted as a function of altitude. (Contractor's abstract)

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

SURFACE CRACKING CAUSED BY ELECTROMAGNETIC WAVE ABSORPTION, by R. C. Good, Jr. [1962] [32]p. incl. illus. diagrs. table, refs. (AFOSR-2295) (AF 49(638)1030) AD 273970 Unclassified

An Exploding Wire Facility has been used to irradiate glass disks to determine any damaging effects. At power levels of 10^7 watts deposited in the wire, the glass surface became crazed. Photomicrographs and profilimeter measurements of the surface are presented to support the following conjectures as to the cause of cracking: the energy radiated by the hot wire is absorbed by a thin surface layer of the glass, the temperature rises creating thermal stresses, flaws below the glass surface form stress raisers according to the Griffith crack theory, and the cracks propagate to the surface. The theoretical derivation of the adapted thermoelastic stress theory predicts the dimensions of the cracks and the power levels required if the absorption coefficient is at least 10^3 cm^{-1}. (Contractor's abstract)

989

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

STRUCTURAL RESPONSE TO INTENSE ELECTROMAGNETIC RADIATION, by R. C. Good, Jr. Annual technical rept. no. 1, Mar. 1, 1961 - Feb. 28, 1962, 62p. incl. illus. diagrs. tables, refs. (AFOSR-2483) (AF 49(638)1030) AD 275042 Unclassified

An exploding wire facility was used as the source of electro-magnetic radiation. Power levels of 10^7 watts were deposited in the wire and the radiation pulse was focused on small specimens of selected materials through reflection in an ellipsoidal mirror. For glass samples, the surface crazed to a depth of 10^{-3} cm. Photomicrographs and profilometer measurements of the surface are presented to support the following conjectures as to the cause of cracking: the energy radiated by the hot wire is absorbed by a thin surface layer of the glass, the associated temperature rise generates thermal stresses, flaws below the glass surface form stress raisers according to the Griffith crack theory, and the cracks subsequently propagate to the surface. The theoretical derivation of the adapted thermoelastic stress theory predicts the dimensions of the cracks and the power levels required if the absorption coefficient is at least 10^3 cm^{-1}. (Contractor's abstract)

990

General Electric Co. Space Sciences Lab., Philadelphia Pa.

DESTRUCTIVE EFFECTS OF PLASMAS GENERATED BY EXPLODING WIRES, by R. C. Good, Jr. [1962] [6]p. incl. illus. diagrs. refs. (AFOSR-J1238) (AF 49-(638)1030) AD 424367 Unclassified

Presented at Seventeenth annual meeting of the Amer. Rocket Soc., Los Angeles, Calif., Nov. 13-18, 1962.

Also published in AIAA Jour., v. 1: 1397-1402, June 1962.

A nominal 10-kj capacitor bank is discharged through a 2-mil tungsten wire in an evacuated chamber. The wire material is heated to about 10,000°K in the first microsecond. A plasma forms with an ion pair density of about 10^{17} ions/cm^3. Nearby glass walls on the chamber are heated to a condition in which microcracks form on the front surface. Electromagnetic waves from the plasma were focused by an ellipsoidal mirror on a glass surface, and craze-cracks were observed. Photomicrographs of the surfaces show that the number of cracks increases as the energy stored in the capacitors is increased from 400 to 3000 joules. Four main processes are postulated for energy transfer to the glass surface: (1) the hot plasma radiate electromagnetic waves; (2) shock waves form, the strength and propagation characteristics of which depend upon the surrounding media; (3) the hot plasma expands to contact the glass surface; (4) wire particles impact on the surface, creating crater-like pock marks. These processes have been separated, and the effects are reported.

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General Electric Co. [Space Sciences Lab.] Philadelphia, Pa..

EFFECTS OF ELECTROMAGNETIC WAVES RADIATED BY AN EXPLODING WIRE (Abstract), by R. C. Good, Jr. [1962] [1]p. [AF 49(638)1030] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 501, Aug. 27, 1962.

A 10-kj capacitor bank is discharged through a 2-mil tungsten wire in an evacuated ellipsoidal chamber. The short wire passes through one focal point and a glass specimen is placed at the second focal point for irradiation. Surface crazing occurs when a 10-μsec pulse of oscillatory current discharges more than 400 J. Photomicrographs of the sample surface show that the number of craze lines increases as the stored energy increases. Measured crack depths corroborate the explanation proposed: Short electromagnetic waves are absorbed by the glass, planar stresses build up from local heating of the surface, and cracks form at internal flaws. Griffith's theory of cracking is adapted to our case by noting that tensile stresses occur at the ends of a narrow fault in a compressive stress field. For the results to be self-consistent, the overall coefficient of absorption must be at least 1000 cm^{-1}.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THE ATTACK BY CESIUM VAPOR ON IMPURE ALUMINUM BODIES AT TEMPERATURES UP TO 1500°C, by E. Feingold. [1962] [6]p. incl. illus. diagrs. tables, refs. (Bound with its Final rept July 1, 1961 - July 31, 1962; AD 284958) (AF 49(638)1092) Unclassified

The purpose of this study was to systematically investigate the phenomena of attack by Cs vapor on alumina. It was determined that: (a) High density, high purity alumina bodies are compatible with cesium vapor for long periods at 1500°C; (b) Silica concentrations on the order of 0.1 w/o or less do not appreciably alter the compatibility of alumina with cesium vapor; (c) Silica concentrations greater than 1 w/o are deleterious and render alumina bodies susceptable to Cs vapor attack at 1050°C; (d) The reaction product resulting when Cs vapor attacks alumina bodies containing silica is $CsAlSiO_4$; (e) the presence of MgO and CaO in concentrations of 1 w/o or less do not alter the compatibility of alumina bodies with Cs vapor; and (f) The reaction product when Cs vapor reacts with fused silica is a Cs_2O-SiO_2 glass. A reactor vessel suitable for carrying out alkali metal attack studies was designed and is described. (Contractor's abstract)

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

CROSSED FIELD MHD PUMP EXPERIMENTS, by T. Nayden, W. Westendorp and H. Hurwitz, Jr. [1962] [12]p. incl. illus. diagrs. table. (Bound with its Final rept. July 1, 1961 - July 31, 1962; AD 284958) (AF 49(638)1092) Unclassified

The success achieved in making operable the crossed field electrical discharge pump illustrates that it is a workable concept and that sonic and supersonic gas velocities can be readily produced if adequate over-all system conductivity is available. At fixed magnetic field and system geometry, gas velocity is determined solely by the current passing between the electrodes. It would seem that almost any gas, including air, could be pumped in this manner if it has the proper electrical characteristics or if it can be properly seeded.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

INVESTIGATION OF ELECTRICAL CONDUCTION IN

GASES WITH ELEVATED ELECTRON TEMPERATURES, by G. W. Sutton. Final rept. July 1, 1961 - July 31, 1962 [144]p. incl. illus. diagrs. tables, refs. (AF 49(638)1092) AD 284958 Unclassified

This is a collection of 7 papers concerning temperature and magnetic effects on electrical conductance in gases. The titles are: Shock Tube Studies of Non-Equilibrium Ionization in a Magnetic Field; The MHD Continuous Flow Experiment; The Attack by Cesium Vapor on Impure Aluminum Bodies at Temperatures up to 1500°C; Spectroscopic Studies on Non-Thermal Ionization; Theoretical Interpretation of Barium Diode Experiments; Theory of a Plasma in a Strong Magnetic Field; and Crossed Field MHD.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THE MHD CONTINUOUS FLOW EXPERIMENT, by F. Shair. [1962] [19]p. incl. illus. diagrs. (Bound with its Final rept. July 1, 1961 - July 31, 1962; AD 284958) (AF 49(638)1092) Unclassified

The object of this research program is to investigate various techniques by which the electrical conductivity of a plasma may be greatly enhanced in the temperature range 1200° - 1700°C. A continuous flow system, (similar to one which will be used for ground, space, and submarine applications), is being developed in order to study the creation and effect of non-equilibrium conditions of the electrons in a plasma. The system has been designed in order that many various measurements of the plasma properties may be obtained. Along with the basic research into MHD power generation, the overall performance and operating characteristics of each unit is being determined as it is integrated into the MHD cycle; finally the cycle will be closed by means of a cooler and compressor. (Contractor's abstract)

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

SHOCK TUBE STUDIES OF NON-EQUILIBRIUM IONIZATION IN A MAGNETIC FIELD, by B. Zauderer. [1962] [15]p. incl. illus. diagrs. (Bound with its Final rept. July 1, 1961 - July 31, 1962; AD 284958) (AF 49(638)1092) Unclassified

In designing the shock tube, it was desired to approximate as closely as possible a steady state MHD generator. Therefore, the following variables were fixed arbitrarily; driven gas - argon plus 1% cesium, temperature behind the shock - 2500°K, pressure - 1 atmosphere. To obtain a non-equilibrium ionization effect it was calculated that a field of 30,000 gauss was needed. In addition the electrode configuration should approximate an actual generator and the gas slug length should be several times longer than the length of the channel. The above experiment is assembled from a series of distinct pieces of apparatus, each of which has to be constructed and tested individually. These items are: the shock tube and its vacuum system; instrumentation to determine the gas dynamic behavior of the shock tube; the magnetic field coil; the electrode assembly; and the diagnostics for the nonequilibrium ionization.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

SPECTROSCOPIC STUDIES ON NON-THERMAL IONIZATION, by M. Linevsky. [1962] [8]p. incl. diagrs. tables. (Bound with its Final rept. July 1, 1961- July 31, 1962; AD 284958) (AF 49(638)1092) Unclassified

The barium atom-ion system was used to investigate the effects of an electric field on the ionization processes. The experiment consists of measuring the effects of an electric field, imposed on a static barium vapor at known pressure and temperature, on the concentration of Ba^+. It was demonstrated that an electric field can cause non-thermal ionization of barium vapor.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THEORETICAL INTERPRETATION OF BARIUM DIODE EXPERIMENTS, by A. Sherman. [1962] [2]p. (Bound with its Final rept. July 1, 1961 - July 31, 1962; AD 284958) (AF 49(638)1092) Unclassified

In order to derive the greatest benefit from the research described in previous experiments (see item 996, item 995, item 992 and item 997) some preliminary attempts were made to reduce the first data obtained.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THEORY OF A PLASMA IN A STRONG MAGNETIC FIELD, by J. Smith. [1962] [23]p. incl. diagr. refs. (Bound with its Final rept. July 1, 1961 - July 31, 1962; AD 284958) (AF 49(638)1092) Unclassified

Inherent to the extension of the Boltzmann equation into the area of the ionized gas is the splitting of the range of interaction into 2 parts; so that, beyond a certain length the interaction is described in terms of an ensemble averaged electric field and within this length the interaction is described as a binary collision. The length over which one can consider the interaction to be purely binary is some distance less than the average interparticle distance and the length beyond which one can speak of the interaction as an ensemble average must be such that the interaction is between many bodies. Thus, there is an ill-defined region, in which 3,4,... bodied interactions are predominate. Therefore, the general assumption is to approximate this ill-defined region by extending the binary region some

distance into the region and do likewise with the ensemble averaged region by assuming that an appropriate division occurs at the Debye length. It is further shown, necessary to the Boltzmann representation, that within the binary range, the external forces are negligible in comparison to the interparticle force. It is the purpose of this report to investigate this latter condition. It is concluded that, at least for the situation in which the distribution functions have cylindrical symmetry about the direction of the magnetic field, the apparent divergence at large impact parameters no longer exists, and therefore that a magnetic field cut-off has in some way been introduced.

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General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

ELECTRON EXCITATION APPLIED TO THE EXPERIMENTAL INVESTIGATION OF RAREFIED GAS FLOWS, by E. P. Muntz and D. J. Marsden. [1962] [32]p. incl. illus. diagrs. tables, refs. (AFOSR-J1048) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1152 and Defence Research Board of Canada) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 2: 495-526, 1963. (AFOSR-5310)

When high energy electrons pass through a gas, inelastic collisions between the electrons and the gas atoms result in a characteristic emission spectrum. The intensity and spectral details of the emission are related to the nature, density, and temperature of the gas, as well as to the energy and number density of the electrons. As a consequence of this, the electroluminescence produced by a known and controlled stream of electrons may be used to determine some otherwise difficult to measure properties of rarefied gas flows. These include: the number density of a particular species, and for some gases the vibrational and rotational temperatures of the molecules in the flow. (Contractor's abstract)

1001

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

SYMPOSIUM ON DYNAMICS OF MANNED LIFTING PLANETARY ENTRY, Philadelphia, Pa., Oct. 1962, ed. by S. M. Scala, A. C. Harrison, and M. Rogers. New York, Wiley and Sons, 1963, 980p. incl. illus. diagrs. table, refs. [AF 49(638)1157] Unclassified

This symposium considered 6 inter-related topics on the dynamics of manned lifting planetary entry. The first session dealt with planetary atmosphere models which are needed to predict the nature of the environment to be encountered by a space vehicle. The subject of the second session was aerodynamic plasma which is formed by shock-wave heating of the gas; it is the determination of the conditions produced by the atmosphere interaction with the space craft. The third session dealt with energy management; the determination of an optimum family of trajectories which will minimize the time-integrated aerodynamic and radiative heating, along with thermal shield requirements. In the fourth session, a series of papers were presented dealing with the full spectrum of aerothermoelastic effects arising from weak to strong thermal coupling. In the fifth session, papers were presented on a wide range of configurations which can be used for the terminal phase of re-entry. The final session on hypervelocity flows dealt with the more rarefied aspects of hypervelocity phenomena, including molecular interactions between gases and solids and effects of surface on thermal accommodation.

1002

General Motors Corp. Allison Div., Indianapolis, Ind.

THERMAL IONIZATION AND RESISTIVITY OF COPPER GAS PLASMA, by G. M. Palmer. May 1961 [16]p. incl. diagrs. (Engineering Dept. rept. no. 2187) (AFOSR-1280) (AF 49(638)864) Unclassified

During a study on the energy efficiency of exploding copper wires for use in rail accelerators, a need arose for the resistivity of copper gas plasma as a function of temperature and pressure. This study was instigated to determine a functional variation of the resistivity. A necessary step along the way is the determination of the ionization level as a function of temperature and pressure and is therefore included as a separate result.

1003

General Motors Corp. Allison Div., Indianapolis, Ind.

PLASMA-ELECTRODE PHENOMENA OF THE RAIL TYPE OF ACCELERATOR, by D. L. Clingman and T. L. Rosebrock. [1962] [2]p. incl. illus. diagrs. (AFOSR-1964) (AF 49(638)864) Unclassified

Also published in ARS Jour., v. 32: 1613-1614, Oct. 1962.

The acceleration process in a rail-type electromagnetic accelerator is investigated. The results indicate a discharge mechanism composed of multiple current-conducting paths in parallel with the main arc discharge. The arc, when operated in the Amperian mode, moves with a velocity several orders of magnitude lower than the bulk of the plasma.

1004

General Precision, Inc. Librascope Div., Glendale, Calif.

A THEORY AND SIMULATION OF RHYTHMIC BEHAVIOR DUE TO RECIPROCAL INHIBITION IN SMALL NERVE NETS, by R. F. Reiss. [1962] [24]p. incl. diagrs. refs. (AFOSR-2955) (AF 49(638)1021) Unclassified

Also published in Proc. 1962 Spring Joint Computer Conf., San Francisco, Calif. (May 1-3, 1962), Palo Alto, National Press, v. 21: 171-194, 1962.

On the basis of a specific conceptual model of signal processing in neurons, together with some fragmentary arguments and evidence in physiological literature, an elementary theory of a multivibrator effect producible by reciprocally inhibiting neurons is developed. The results of exploratory simulation experiments are described, and speculations on the possible role of the multivibrator effect in semiautomatic muscle control systems are presented. (Contractor's abstract)

1005

General Precision, Inc. Librascope Div., Glendale, Calif.

AN ABSTRACT MACHINE BASED ON CLASSICAL ASSOCIATION PSYCHOLOGY, by R. [F.] Reiss. [1962] [18]p. incl. diagrs. refs. (AFOSR-2557) (AF 49(638)-1039) Unclassified

Also published in Proc. 1962 Spring Joint Computer Conf., San Francisco, Calif. (May 1-3, 1962), Palo Alto, National Press, v. 21: 53-70, 1962.

For abstract see item no. 1006, Vol. VI.

1006

General Precision, Inc. Librascope Div., Glendale, Calif.

AN ABSTRACT MACHINE BASED ON CLASSICAL ASSOCIATION PSYCHOLOGY, by R. [F.] Reiss. [1962] [18]p. incl. diagrs. refs. (AFOSR-2618) (AF 49(638)1039) Unclassified

Also published in Proc. 1962 Spring Joint Computer Conf., San Francisco, Calif. (May 1-3, 1962), Palo Alto, National Press, v. 21: 53-70, 1962.

The theories of classical association psychology (~1750-1900) attempted to explain human thought processes in terms of certain mechanistic forces operating on discrete entities called sensations, images, and ideas. Although these theories have become unfashionable since the turn of the century, due to their ambiguity and the difficulty of experimental verification, and whereas they may never prove adequate for human psychology, it is possible that they may provide a fruitful basis for some types of artificial intelligence. One method of exploring ramification of the classical theories is the formulation of an abstract machine which constitutes an interpretation of the theories and whose behavior can be examined in any desired detail. In this paper such a machine is partially constructed, and some of its behavioral features and problems are discussed. (Contractor's abstract)

1007

Genoa U. Neurosurgical Clinic (Italy).

[INDUCTION OF DEEP SLEEP IN CATS BY MEANS OF ELECTRICAL STIMULATION OF THE RETICULAR FORMATION OF THE BRAIN-STEM] Induzione del sonno profondo nel gatto mediante stimolzione elettrica della sostanza reticolare del tronco encefalico, by E. Favale, A. Giussani, and G. F. Rossi. [1961] [2]p. incl. refs. (AFOSR-745) (AF 61(052)461) AD 258871 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 37: 265-266, 1961.

The results obtained were the following: (1) stimulation of the reticular formation capable of arousing the animal from a light sleep became ineffective during medium sleep; (2) the same reticular stimulation during the awakening stage of a medium sleep (when the EEG and EMG activity patterns suggested a transition towards deep sleep) evoked the appearance of typical EEG and EMG patterns of deep sleep; (3) the marked rise of the arousal threshold to sensory auditory stimuli showed that a real deep sleep was induced by reticular stimulation; (4) the induced deep sleep was of similar duration to the natural deep sleep (15-20 min); and (5) the induction of deep sleep was produced by the stimulation of the reticular structure of the mesencephalation, the pons and the medulla oblagata.

1008

Genoa U. [Neurosurgical Clinic] (Italy).

BLOOD PRESSURE DURING NATURAL SLEEP AND DURING SLEEP INDUCED BY ELECTRICAL STIMULATION OF THE BRAIN STEM RETICULAR FORMATION, by O. Candia, E. Favale and others. [1962] [18]p. incl. illus. refs. (AFOSR-4170) (AF 61(052)461) Unclassified

Also published in Arch. Ital. Biol., v. 100: 216-233, Mar. 1962.

Arterial blood pressure was recorded in intact, unanesthetized, free moving cats through a cannula permanently inserted into the carotid or femoral artery. The cats were also carrying implanted electrodes for EEG and EMG recording and for electrical stimulation of peripheral and central nervous structures. Blood pressure changes during sleep were analyzed and compared with those occurring in the electrocortical rhythms and in the electrical activity of the posterior cervical muscles. A constant and marked blood pressure fall is observed during deep sleep, when the EEG rhythms are desynchronized and the EMG becomes completely flat. The threshold of arousing stimuli is related to the level of the blood pressure, reaching its highest values in coincidence with the lowest pressure levels and viceversa. The behavior of the blood pressure during deep sleep episodes induced by electrical stimulation of the brain stem reticular formation is similar to the one observed during the natural episodes of deep sleep. The conclusion is reached that the study of the blood pressure provides important information

on the depth of sleep. Electrocortical rhythms, electrical activity of the posterior cervical muscles and blood pressure should be recorded simultaneously in order to obtain a correct and reliable evaluation of the deepness of sleep. On the basis of the present and of previous results, sleep is subdivided into 2 fundamental phases: (1) light sleep, characterized by EEG synchronization, moderate muscular tonus and basal blood pressure level and (3) deep sleep which is characterized by EEG desynchronization, complete muscular relaxation and marked decrease of the blood pressure.

1009

Genoa U. [Neurosurgical Clinic] (Italy).

ELECTROPHYSIOLOGICAL STUDY OF THE NEURAL MECHANISMS OF SLEEP, by G. F. Rossi. Final rept. Oct. 1960 - Sept. 1962. Oct. 1962, 10p. incl. refs. (AFOSR-4189) (AF 61(052)461) AD 292999
Unclassified

The aim of the research was to study with electrophysiological techniques the neural mechanisms underlying sleep. The findings obtained were summarized: (1) 2 phases of stages of sleep having very well distinguished electrocortical and somato-visceral characteristics can be recognized in the cat; (2) the desynchronized activity present during the second phase of sleep, or deep sleep, seems to result from a depression of the subcortical EEG synchronizing systems produced by the action of an inhibitory mechanism; (3) adequate electrical excitation of the brain stem reticular formation is followed by the appearance of deep sleep; (4) a transverse unilateral hemisection of the brain stem at pontine level prevents the appearance of the electrocortical rhythms of deep sleep on the ipsilateral cerebral hemisphere; and (5) the same transection decreases or even suppresses deep sleep itself. Findings lead to the following conclusions: (1) the second phase of sleep, or deep sleep, has an active origin, being produced by an inhibitory or sleep-inducing influence; and (2) the inhibitory or sleep-inducing influence responsible for deep sleep takes origin from the caudal brain stem, probably from structures of the rostral half of the pons.

1010

Genoa U. Neurosurgical Clinic (Italy).

[STUDY OF THE MECHANISMS OF SLEEP IN CATS. EFFECT OF UNILATERAL LESIONS OF THE BRAINSTEM ON EEG] Studio dei meccanismi del sonno nel gatto. Effetti elettroencefalografici di lesioni unilaterali del tronco dell' encefalo, by K. Minobe, O. Candia, and G. F. Rossi. [1962] [3]p. (AFOSR-J196) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)461, Consiglio Nazionale delle Richerche, and Rockefeller Foundation)
Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 38: 1137-1139, 1962.

Interpretation of EEG asymmetries occurring at the onset of sleep, observed during deep sleep, seemed to lead to the following conclusions: (1) conformation of the hypothesis of the origin of EEG activity characteristic of deep sleep and therefore the existence of an active sleep mechanism;and (2) that the ascendant impulses responsible for EEG patterns originated from a narrow zone of the brainstem situated between the rostral and middle part of the brainstem.

1011

Genoa U. Neurosurgical Clinic (Italy).

[PERSISTENT INSOMNIA DUE TO EXPERIMENTAL SURGICAL LESIONS OF THE PONS] Persistente insonnia da lesioni chirugiche sperimentali del ponte, by O. Candia, K. Minobe, and G. F. Rossi. [1962] [3]p. (AFOSR-J197) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)461, Consiglio Nazionale delle Richerche, and Rockefeller Foundation)
Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 38: 1139-1141, 1962.

Experiments made with cats to study EEG variations due to unilateral lesions of the brainstem show that lesions situated on the anterior of the rostral pons increase the amount of sleep and those situated in the posterior level decrease the amount of sleep. Variation in light sleep may increase or decrease, and deep sleep decreases or is at least suppressed. The hypnogenetic influence responsible for that phase of deep sleep originated from the rostral half of the pons or a point situated directly posteriorly at the same level.

1012

Genoa U. Neurosurgical Clinic (Italy).

[VARIATIONS OF THE ELECTROENCEPHALOGRAM, THE ELECTROMYOGRAM AND THE ARTERIAL BLOOD PRESSURE DURING SLEEP IN THE RABBIT] Comportamento dell' elettroencefalogramma, dell' elettromiogramma e della pressione arteriosa durante il sonno nel Coniglio, by F. Bonamini, V. De Carolis and others. [1962] [2]p. (AFOSR-J262) (AF 61(052)461)
Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 38 1300-1302, 1962.

From the results obtained during these experiments it can be inferred that the most reliable indication of the depth of sleep in the rabbit is presented by the synchronization of EEG fluctuations. Unlike the dog and cat it is impossible to distinguish the 2 stages of sleep in the rabbit. The rabbit's behavior (relative uniformity of the arousal threshold, no occurrence of complete muscular relaxation and marked decrease of blood pressure at the same time as an increase of arousal threshold) led one to believe that the depth of sleep in the rabbit is never that attained in the cat and dog.

1013

Genoa U. Neurosurgical Clinic (Italy).

[LIGHT AND DEEP SLEEP IN DOGS (STUDY OF THE ELECTROENCEPHALOGRAM, ELECTROMYOGRAM AND BLOOD PRESSURE] Sonno superficiale e sonno profondo nel cane. (Studio elettroencefalografico, elettromiografico e pressorio), by F. Bonamini, V. De Carolis and others. [1962] [3]p. (AFOSR-J263) (AF 61(052)461) Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 38: 1298-1300, 1962.

Studies on cats showed that physiological sleep presented 2 major forms: light sleep and deep sleep, each having characteristic EEG patterns. Experiments were also carried out with dogs. Results showed that 2 stages in the depth of sleep have characteristic EEG, EMG, and blood pressure similar to that encountered in cats which could be inferred that the explanation of the mechanism of cats sleep could also be applied to the dog.

1014

Genoa U . Neurosurgical Clinic (Italy).

[ELECTROPHYSIOLOGICAL RESEARCH ON SLEEP IN THE DOG AND RABBIT] Richerche elettrofisiologiche sul sonno del cane e del coniglio, by F. Bonamini, V. De Carolis and others. [1962] [20]p. incl. illus. diagrs. refs. (AFOSR-J703) (AF 61(052)461) AD 612870 Unclassified

Also published in Riv. Neurobiol., v. 8: 394-413, Oct.-Dec. 1962.

The sleep of the normal dog and rabbit has been studied. The electrical neocortical rhythms, the electrical activity of the posterior cervical muscles, the blood pressure level and the behavior of the animals during sleep have been analyzed and related to the threshold of arousal by electrical subcutaneous stimulation. Two phases of sleep of different depth, quite similar to those previously observed in the cat, have been found in the dog: a light sleep phase characterized by synchronized EEG rhythms, moderate EMG activity and normal blood pressure level; a deep sleep phase, characterized by desynchronized EEG, flattening of the EMG, very low blood pressure level and twitching of the facial muscles. This subdivision of sleep in 2 phases is not possible in the rabbit. The most reliable index of the occurrence and depth of sleep in this animal has been identified with the occurrence of EEG synchronization. The sleep of the rabbit does not appear to reach the depth of that of the dog or cat. The partial disagreement between the present findings and those obtained in other laboratories is pointed out and discussed. Two possible explanatory hypothesis are advanced. (Contractor's abstract)

1015

Genoa U. Neurosurgical Clinic (Italy).

[NEW CONSIDERATIONS ON THE PHYSIOPATHOLOGICAL MECHANISMS IN THE VARIATIONS OF CONSCIOUSNESS] Nuove considerazioni sui meccanismi fisiopatologici delle variazioni di coscienza, by G. F. Rossi. [1962] [36]p. incl. refs. (AFOSR-J381) (AF EOAR-62-106) Unclassified

Also published in Minerva Neurochirurgica, v. 6: 129-141, Oct.-Dec. 1962.

Recent experimental research on the problem of neurogenic mechanisms in the quantitative changes of consciousness shows that, apart from the well-known brainstem activating mechanisms, there also exist inhibiting or hypnogenic mechanisms in the brainstem. The hypothesis is advanced that a lowering of the level of consciousness may be the result of a twofold mechanism: one by passive action through hypoactivity of the activating systems, and on the other by active action through hyperactivity of the inhibiting or hypnogenic systems. Although the clinical findings reported in the literature confirm the existence of activating mechanisms, they only reveal a few factors pointing to the existence of mechanisms which inhibit the level of consciousness. The apparent discrepancy between clinical and experimental findings is discussed and some interpretations are suggested.

1016

George Washington U. [Dept. of Chemistry] Washington, D. C.

A STUDY OF THE REACTIONS BETWEEN ALKALI METALS AND CARBON MONOXIDE, by W. F. Sager Final rept. Feb. 14, 1962, 2p. (AFOSR-2226) (AF 49-(638)325) Unclassified

The reaction between metallic potassium and carbon monoxide is found to proceed according to the following stage: $K + CO \rightarrow (K_2C_2O_2)_n \rightarrow (KCO)_n$. This substance, $(KCO)_n$ when heated in the presence of CO_1 is converted to the potassium salt of hexahydroxy benzene. When KCO is treated with methyl iodide or a solution of methyl iodide, it yields a product of molecular formula $C_8H_{12}O_4$ possessing 2 methoxyl groups and showing carbonyl absorption in the infrared spectrum.

1017

Georgetown U. Dept. of Physics, Washington, D. C.

A THEORETICAL STUDY OF THE VIBRATIONAL ENERGY LEVELS OF DIATOMIC MOLECULES, by C. L. Beckel. Final rept. Jan. 1960 - June 1962, 6p. (AFOSR-3031) (AF AFOSR-60-1) AD 613375 Unclassified

The lowest vibrational levels associated with both the Heitler-London (HL) potential, and the 2 potentials for ionic molecules were found by a power series expansion

method which revealed considerably more information than anticipated. In particular, the convergence of the covalent vibrational energies was very different from that of the ionic energies. The WKB method was used to find all vibrations associated with the rapid convergence characteristic of covalent molecules. The behavior of the higher HL vibrations was very nearly the same as that of the experimental levels of H_2; this behavior coupled with near-equilibrium data led to a predicted dissociation energy which is 99% of the experimental value. The higher vibrational levels of the ionic molecules converged very slowly and approached hydrogen atom-like levels. This fact was used to obtain equations for the theoretical vibrational energies valid for all vibrational quantum numbers. The equations were applied to LiI, NaCl, and InF. Two additional steps were undertaken which were not originally proposed: (1) Eleven theoretical potential curves for H_2 were made available and were vibrationally analyzed; and (2) The application of the WKB method to radial problems was studied. The substitution of $(J + 1/2)^2$ for $J(J + 1)$ in the effective potential was shown to be justified for the first-order WKB approximation only. The second-order approximation requires a far smaller correction. This result was applied to the vibrating rotator problem and was used in the vibrational analyses.

1018

Georgetown U. [Dept. of Physics] Washington, D. C.

APPLICATION OF THE SECOND-ORDER WEAK APPROXIMATION TO RADIAL PROBLEMS (Abstract), by J. Nakhleh and C. L. Beckel. [1962] [1]p. [AF AFOSR-60-1] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 215, Mar. 26, 1962.

Theoretical considerations and a number of actual examples have shown that the WBK approximation applied to radial problems requires use of $(J + 1/2)^2$ in place of $J(J + 1)$ in the effective potential. However, all previous examples have taken account of the first-order WBK approximation only. The second-order WBK wave function obeys a differential equation which approaches Schrödinger's as $r \to 0$, if one uses $J(J + 1) - 1/[64J(J + 1)]$ in place of $J(J + 1)$ in the effective potential whenever $J \neq 0$. Solution of the second-order WBK energy integrals and comparison with exact results for the H atom and the radial, harmonic oscillator confirms use of $J(J + 1) - 1/[64J(J + 1)]$. Thus, it appears that at each level of WBK approximation a different effective potential is to be used. Implications with regard to Dunham's treatment of the rotating-vibrator are discussed.

1019

Georgetown U. [Dept. of Physics] Washington, D. C.

VIBRATIONAL ANALYSIS OF THE HEITLER-LONDON POTENTIAL OF H_2, by C. L. Beckel. [1962] [1]p. [AF AFOSR-60-1] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 215, Mar. 26, 1962.

The vibrational levels associated with the Heitler-London potential of H_2 have been found through use of the WBK approximation. The ΔG (first vibrational-energy difference) vs v (vibrational quantum number) curve has a negative curvature at all v. This contrasts with the experimental curve which has a slight positive curvature at low v, and indicates that ionic contributions are responsible for the positive curvature. At high v, the Heitler-London vibrational levels show the rapid-convergence characteristic of H_2 and other covalent molecules. A comparison is made of the rate of convergence of the experimental, Heitler-London, and Weinbaum vibrational levels of H_2.

1020

Georgetown U. Dept. of Physics, Washington, D. C.

VIBRATIONAL CONSTANTS FOR THE GROUND STATE OF H_2, by M. Shafi and C. L. Beckel. [1962] [2]p. incl. tables. (AFOSR-J16) (AF AFOSR-62-160) AD 297257 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2732-2733, Dec. 1, 1962.

The expression $\Delta G = [A-B(v + 1/2)]/[1-C(v + a)^n]$ (1) was found to fit the experimental ΔG values of H_2 more satisfactorily than the usual power series. The ΔG's are the first vibrational energy differences, and A, B, C, a, and n are adjustable parameters. Since slight changes in a and n do not produce significant changes in the results, a simplified least square method was used to fit equation 1 to the experimental ΔG's. An exact fit to 5 points was used to obtain the value of n. With this n, an exact fit to 4 points gave a. With these values of a and n, a least squares calculation yielded A, B, and C. Results of fitting this expression at 7 and at 10 points are presented in tabular form. Comparison of the 5-constant, 10-point fit of the expression with the 4-constant, 8-point power series fit shows the superiority of equation 1. For both, the above equation represents the experimental ΔG's within the range of fit except at $1\frac{1}{2}$ and $2\frac{1}{2}$.

1021

Georgetown U. Dept. of Physics, Washington, D. C.

THEORETICAL VIBRATIONAL ENERGY LEVELS OF

H_2 ASSOCIATED WITH VARIOUS COMBINATIONS OF MOLECULAR-ORBITAL CONFIGURATIONS, by G. M. Leies. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J80) (AF AFOSR-62-160) AD 400461 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1418-1424, Oct. 1, 1962.

A theoretical examination has been made of the influence of MO configurations on the spacing of the vibrational levels of H_2. Eleven previously determined potential curves for the H_2 ground state, based upon LC STO MO wave functions with configuration interaction, have been used to calculate vibrational-energy levels and their first differences ΔG. Comparison of the 11 curves of ΔG vs vibrational quantum number v shows that only when the wave function contains the configuration $(\sigma_\mu 1s\sigma_\mu 1s')$ does the ΔG curve have a shape similar to that of the experimental ΔG curve. The combination of $(\sigma_g 1s\sigma_g 1s')$ and $(\sigma_\mu 1s\sigma_\mu 1s')$ provides left-right correlation of variable ionicity and this ionicity is found to vary in the same manner as the curvature of the ΔG curve. The addition of $(\sigma_g \zeta s\sigma_g 2p)$ which gives in-out correlation, and $(\tau\mu\ 2p\ \overline{\nu}\ \mu\ 2p)$, which provides angular correlation, to the wave function raises the ΔG curve especially at large V. The use of ΔG curves obtained from simple wave functions to estimate dissociation energies is discussed.

1022

Georgia Inst. of Tech. Engineering Experiment Station. Atlanta.

MECHANISM OF THE PHASE TRANSITION IN QUARTZ, by R. A. Young. Final rept. Apr. 30, 1962, 156p. incl. diagrs. tables. (AFOSR-2569) (AF 49(638)624) AD 276235 Unclassified

The α-β phase transition at 573°C is shown to be directly occasioned by the oxygen atom's thermal vibrations normal to the Si-O-Si plane and to be a first order transition, not an order-disorder type. The α-β transition proper is generally preceded by a special type of secondary transition, consisting of extensive small scale Dauphiné twinning. The extensive twinning often produces enough strain to give considerable extinction relief and is probably responsible for the fuzzing of optical signals and occasional suggestions in the literature that a phase intermediate between α and β exists. In this x-ray study, the coordinate parameters and thermal ellipsoids were determined as a function of temperature by least squares refinements at 8 temperatures from 450° to 650°C. R-factors are generally less than 4%. Specially collected data allowed a particularly good determination of the 600°C β-structure to be made (x = 0.4137 ± 0.0015). Study of individual reflection intensities as continuous functions of temperature, throughout a range including the transition, made the following possible: (1) the unambiguous choice of a single over a double minimum model for the configurational potential energy of the β-phase and (2) the detection and study of the Dauphiné twinning (long range order) aspect of the overall transition. (Contractor's abstract, modified)

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Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

MASS SPECTROMETRIC STUDY OF ION-MOLECULE REACTIONS OCCURRING AT THERMAL ENERGIES UNDER GAS KINETIC CONDITIONS, by D. W. Martin and W. S. Barnes. Final rept. Mar. 31, 1962, 11p. (AFOSR-2769) (AF 49(638)1064) AD 278100 Unclassified

Ion-molecule reactions occurring at near thermal energies in a gas were studied by a method in which the products of such reactions are identified by means of a mass spectrometer. Special apparatus for this study was developed. Activity consisted of exploration of the potentialities of this apparatus, making modifications and improvements where desirable, and application of the apparatus to studies of certain ion-molecule reactions of basic general interest.

1024

Georgia Inst. of Tech. [Engineering Experiment Station] Atlanta.

SIMULTANEOUS INDEPENDENT MEASUREMENT OF THE MOBILITIES AND DIFFUSION COEFFICIENTS OF IONS IN NITROGEN (Abstract), by D. W. Martin, W. S. Barnes and others. [1962] [1]p. [AF AFOSR-62-306] Unclassified

Presented at meeting of the Amer. Phys. Soc., Boulder, Colo., Oct. 10-12, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 634, Dec. 27, 1962.

The mobilities and diffusion coefficients of various ions in nitrogen are measured by a time-analysis method in which ion pulses are generated at 1 of 3 sources located along the axis of a tube containing nitrogen at pressures from 0.05 - 1.0 Torr. The ions formed are drawn by a weak electric field of 1-4 v/cm toward 1 end of the tube where they are swept into a mass spectrometer. The output of the spectrometer is time-analyzed to determine the drift time and spread of each ion pulse. From an analysis of the time spectra, the mobilities and diffusion coefficients can be separately determined. Data on the primary ions N^+ and N_2^+ are presented, and the formation and transport properties of secondary ions (N_3^+, N^{4+}) produced in ion-molecule reactions are discussed.

1025

Georgia U. [Bioelectronic Computer Lab.] Athens.

THE REACTION OF BLINDED GOLDFISH TO ROTATION IN A CENTRIFUGE, by H. C. Howland and B. Howland. [1962] [12]p. incl. diagrs. tables. (AFOSR-4324) (AF 49(638)1011) Unclassified

Also published in Jour. Exper. Biol., v. 39: 491-502, Dec. 1962.

Blinded goldfish behave in a centrifuge as if they were orienting to absolute rotation by means of a Foucault pendulum. That is, they swim so as to compensate the rate of imposed rotation about the apparent vertical. The blinded goldfish swim in the centrifuge in a plane essentially orthogonal to the apparent vertical at low accelerations and low rates of rotation. With higher rates of rotation, the axis about which the fish swims leans away from the apparent vertical and towards the axis of rotation of the centrifuge. Analysis of the physics of the centrifuge shows that if the fish rotates about any axis relative to the cab of the moving centrifuge with a rate of rotation within the physiological range of its semicircular canals it will receive signals from its otocysts and its semicircular canals which would reflect contradictory information in a non-rotating environment. This fact, together with the fish's response to absolute rotation, affords a method for quantitatively assessing the relative roles of the otocysts and the semicircular canals in orienting the free-swimming fish.

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Georgia U. [Dept. of Sociology] Athens.

THE IMPACT OF TECHNOLOGICAL CHANGE ON THE STRUCTURE AND FUNCTION OF LARGE-SCALE ORGANIZATIONS, by S. P. Greenspon. [1961] 88p. (AFOSR-2246) (AF 49(638)804) AD 612195 Unclassified

This study is a part of a project proposing to study the introduction of technological change and its impact on the career professionals and executives who run large-scale organizations technically and administratively. The study undertakes the task of analyzing the independent variable, i. e. the technological change variable. Concern is with 2 sources of innovations: those generated by research in the physical sciences, and those generated by research in the social sciences. There is reason to believe that each type will tend to have a somewhat different impact on a large-scale organization, or may well affect the components of the organization in a somewhat different sequence The typology has 2 distinguishable categories: the mechanical-technical variety as generated by the physical sciences, and the administrative-social variety as generated by the social sciences. To study the impact of such innovations on large-scale organizations, it will also be necessary to have an organizational model of the basic components which comprise an organization. The components to be included are: organizational goals; the formal organization which includes the distribution of functional activities and the formal authority structure; the informal organization; and the reward system. Case studies of various large-scale organizations into which such change was introduced are examined. Represented in these case studies are: industry, the military, hospitals, prisons, and the governmental agencies.

1027

Georgia U. [Dept. of Sociology] Athens.

STUDIES IN ORGANIZATIONAL EFFECTIVENESS, by R. V. Bowers. [1962] [326]p. incl. diagrs. tables, refs. (AFOSR-3495) (AF 49(638)804) AD 290249 Unclassified

The topics discussed in this paper are: (1) role conflict, role ambiguity, and morale and human relations leadership as factors in organizational effectiveness; (2) members' perceptions and evaluations as measures or organizational effectiveness; and (3) the role succession factor in organizational effectiveness. (Contractor's abstract, modified)

1028

Georgia U. [Dept. of Sociology] Athens.

AN EMPIRICAL INVESTIGATION OF SOME HYPOTHESES TAKEN FROM THE LONELY CROWD, by J. R. Alewine. Aug. 1962, 54p. incl. tables, refs. (AFOSR-4[illegible]2) (AF 49(638)804) AD 289800 Unclassified

Certain hypotheses which were derived from The Lonely Crowd were empirically tested. The hypotheses were divided into 2 groups. Group I contains 5 hypotheses concerning childhood socialization experiences: (1) the inner-directed person is more likely to have been reared to be more self-reliant; (2) more interested in thrift; (3) more ambitious; and (4) more interested in work; and (5) reared by stricter parents than the other-directed person. The 4 hypotheses of Group II concerning demographic factors were: (1) the older people today are more likely to be inner-directed; (2) inner-directed people were more likely to have been reared in rural and small town areas than other-directed people; (3) the fathers of inner-directed respondents are likely to have had less formal education than fathers of other-directed respondents; and (4) the fathers of inner-directed respondents were more likely to have been self-employed than the fathers of other-directed respondents. (Contractor's abstract)

1029

Giannini Controls Corp. [Astromechanics Research Div., Malvern, Pa.]

DETAILED INSTRUCTIONS FOR THE USE OF PREVIOUSLY PUBLISHED DECAY-DAMPING RELATIONSHIPS, by A. G. Fonda. Apr. 1962 [40]p. incl. diagrs. (AFOSR-2849) (AF 49(638)1015) AD 276570 Unclassified

A practical and accurate method of converting conventionally computed flutter data into the roots of aeroelastic system dynamic response is presented. These latter are currently found almost exclusively by test and almost never analytically because of severe computational difficulties. The differences and similarities between these 2 sets of parameters are delineated and discussed. The computational procedure presented in this report related the flutter roots to the system

dynamic response roots by establishing, in closed form, the rate of change of the latter with the former. As is shown, this rate of change is fortunately tolerant of aerodynamic complexity, and furthermore it can be calculated with little or no knowledge of the original system; that it is purely from the conventional flutter data itself. Step-by-step rules to guide this transformation are given in the first section of this report, accompanied by appropriate suggestions and aids to practical use. These are then demonstrated in typical use. A second section proves the algebraic validity of the method. This section is presented separately so that the step-by-step procedure of the first section can be set forth with maximum clarity.

1030

Giannini Controls Corp. Aeromechanics Research Div., [Malvern, Pa.]

NEW DYNAMIC SYSTEM CONCEPTS AND THEIR APPLICATION TO AEROELASTIC SYSTEM APPROXIMATIONS, by M. B. Zisfein and F. J. Frueh. [1961] [25]p. incl. diagrs. (AFOSR-3732) (AF 49(638)1015) Unclassified

A resume of the conception and early development of certain logical concepts germane to dynamic systems is presented. The base curve, high damping asymptotes, and high decay asymptote are introduced and it is shown how these particular concepts may be combined with existing dynamics technology to derive new aeroelastic system approximations. To demonstrate their validity, these approximations are compared to rather tedious numerical solutions and, where available, to experiment. Future efforts will consist of generalization of these techniques plus exploration for additional approximate solutions which may be of further value.

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Giannini Controls Corp. [Astromechanics Research Div., Malvern, Pa.]

PARAMETRIC ACCURACY STUDY OF A PREVIOUSLY PUBLISHED DECAY-DAMPING RELATIONSHIP, by A. G. Fonda. Dec. 1962 [104]p. incl. diagrs. tables. (Rept. no. ARD TR-02-003) (AFOSR-4615) (AF 49(638)1015) AD 292343 Unclassified

A method has been previously published, with algebraic proof, for the approximation of the motion decay coefficients of aeroelastic systems from their conventionally computed required damping coefficients. Results found by this method, for many combinations of conditions, are compared with exact results found by otherwise less satisfactory methods. Recent refinements of the original technique are presented. The decay-damping relationship proves extremely accurate in most instances. Large errors prove to be strongly correlated with certain parameters of the solution, forming dependable error indicators within the method. The decay-damping transformation extends the conventional flutter solution technique into a full predictor of classical system response; the present report completes a series of reports introducing this method for general use. (Contractor's abstract)

1032

Göttingen U. [Inst. of Physiology] (Germany).

RADIO TRANSMITTED UNIT ACTIVITY IN THE BRAINSTEM OF CONSCIOUS, UNRESTRAINED CATS, by R. von Baumgarten. Final rept. Oct. 30, 1962, 19p. incl. refs. (AFOSR-4181) (AF 61(052)470) AD 292972 Unclassified

A technique of wireless transmission of single nerve cell activity from the brain of unrestrained, freely-moving cats to a recording system was developed. With this new method, specific patterns were recorded in all parts of the cortex, the basal ganglia, the thalamus, and the ammonshorn. The differences in the firing pattern of single nerve cells were studied in the cortex of conscious and subsequently anesthetized cats. The pattern in unanesthetized preparations is much more irregular than that in the anesthetized. Changes in the firing pattern were compared with changes in the motor behavior. In the sensorimotor cortex of cats, units could be recorded which discharged only when the cat walked and ceased firing when it stopped walking. In the globulus pallidus, units were recorded which were facilitated during turning movements of the cat toward the contralateral side. The effect of optical and acoustical stimulation in the awake animal was studied. Typical optical effects were restricted to the visual areas, whereas strong acoustic stimulation caused a temporary general inhibition of unit activity over most of the cortical areas. Histological controls of the site of the microelectrode tip were performed regularly. This data, together with the corresponding specific unit patterns and the protocolled behavior during recording will be used in the preparation of a new neurophysiological brain atlas.

1033

Gothenburg U. [Dept. of Biology] (Sweden).

INTRANEURONAL MECHANISMS FOR INFORMATION STORAGE. THE BIOCHEMICAL RELATIONSHIP BETWEEN NEURON AND GLIA, by H. Hydén. Final rept. Apr. 1, 1959 - Mar. 31, 1962. Apr. 30, 1962, 13p. incl. tables, refs. (AFOSR-2672) (AF 61(052)248) AD 276234 Unclassified

A conspicuous feature of the neurons is their capacity to produce ribonucleic acids (RNA) and proteins on a large scale. This activity was as characteristic of neurons as is the generation of bioelectric potentials and is intimately linked with the specialized nervous function. When the stimulation of a group of neurons is increased, production of RNA and proteins also increases. The neuron is structurally and biochemically similar to an enormous gland cell. Sensory deprivation showed that stimuli are equally important for the maintenance of the nervous function during the life cycle. An intimate morphological relationship between the glial cells and the neurons is discussed. A

distinction was made between neutronal glia (mainly oligodendrocytes) and capillary glia (mainly astrocytes). On stimulation, glial potentials have been obtained which are 700 to 1000 times slower than those generated by the neurons. In cultures glial cells have been observed to climb along neurons like spiders, suggesting a pronounced affinity. The glia have been shown to exhibit pinocytosis and to react with structural changes earlier than did the neurons under experimental conditions. (Contractor's abstract)

1034

Gothenburg U. [Dept. of Biology] (Sweden).

NUCLEAR RNA CHANGES OF NERVE CELLS DURING A LEARNING EXPERIMENT IN RATS, by H. Hydén and E. Egyházi. [1962] [8]p. incl. illus. tables, refs. (AFOSR-2887) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)248 and National Multiple Sclerosis Society) Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 1366-1372, Aug. 1962.

Increases occurred in the adenine/uracil ratio of nuclear RNA and in the amount of RNA/cell during the learning process. These changes in the nuclear RNA of the nerve cell were not due to demands on the neural function per se. Nuclear RNA changes during learning are considered to be due to activation of regions on the chromosomes with the production of nuclear (chromosomal) RNA with highly specific base ratios.

1035

Gothenburg U. [Dept. of Biology] (Sweden).

CHANGES IN THE BASE COMPOSITION OF NUCLEAR RIBONUCLEIC ACID OF NEURONS DURING A SHORT PERIOD OF ENHANCED PROTEIN PRODUCTION, by H. Hydén and E. Egyházi. [1962] [8]p. incl. illus. tables, refs. (AFOSR-J209) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-62-29 and National Multiple Sclerosis Society) AD 299893 Unclassified

Also published in Jour. Cell Biol., v. 15: 37-44, Oct. 1962.

Nuclei from isolated nerve cells were sampled by microdissection. Analyses, were made of control nerve cells and of cells in which an enhanced RNA and protein production had been induced by chemical means, tricyano-amino-propene. The nuclear RNA content of the control nerve cells was 56 $\mu\mu$g. The base ratios were: adenine 21.3, guanine 26.6, cytosine 30.8, uracil 21.3. Purine-pyrimidine analyses showed that the nuclear RNA differed significantly from the cytoplasmic RNA in having higher adenine and uracil values. The guanine and cytosine values were high, however, and the ratio G/C was 0.86 as compared with 1.16 for the cytoplasmic RNA. During the 60 min. of enhanced neuronal RNA production (+25%) the guanine value increased and the uracil value decreased significantly in the nuclear RNA. In the cytoplasmic RNA the guanine value also increased although not so much as the nuclear guanine. The cytoplasmic cytosine value decreased. The results indicated that the production of the characteristic cytoplasmic RNA had been influenced by the change in the nuclear RNA. (Contractor's abstract, modified)

1036

Gothenburg U. [Dept. of Biology] (Sweden).

THE NEURON AND ITS GLIA - A BIOCHEMICAL AND FUNCTIONAL UNIT, by F. H. Hydén. [1962] [12]p. incl. illus. diagrs. tables, refs. (AFOSR-J471) (AF EOAR-62-29) AD 407893 Unclassified

Also published in Endeavour, v. 21: 144-155, Oct. 1962.

The investigations in neurochemistry are of interest not only because of their fundamental significance for the understanding of nervous function but because of the extreme delicacy of the biological and biochemical manipulations. The experimental evidence indicates a very close relationship between the neuron and its glia, the latter apparently constituting an effective feedback mechanism co-ordinating the electrical and biochemical processed in the neuron. (Contractor's abstract)

1037

Gothenburg U. Dept. of Pharmacology (Sweden).

NEW EVIDENCE FOR THE LOCALIZATION OF NORADRENALIN IN THE ADRENERGIC NERVE TERMINALS, by B. Falck and A. Torp. [1962] [4]p. incl. refs. (AFOSR-4202) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-61-44 and Public Health Service) Unclassified

Also published in Med. Exper., v. 6: 169-172, 1962.

By means of an essential modification of a previously developed fluorescence method, it now seems possible to demonstrate directly the adrenergic transmitter, noradrenalin, in the adrenergic nerve terminals. The method is based upon the principle that the amine in freeze dried tissues can be condensed with formaldehyde under nearly dry conditions to intensely fluorescent products. (Contractor's abstract)

1038

Gothenburg U. Dept. of Pharmacology (Sweden).

OBSERVATIONS ON THE POSSIBILITIES OF THE CELLULAR LOCALIZATION OF MONOAMINES BY A FLUORESCENCE METHOD, by B. Falck. [1962] [21]p. incl. illus. refs. (AFOSR-4327) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-61-44, Public Health Service, and Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 56: 7-24, 1962.

Catecholamines and 5-hydroxytryptamine form highly fluorescent condensation products when treated with formaldehyde. If freeze-dried preparations are treated with dry formaldehyde gas at approximately 80° for 1 hr, these condensation products are formed in tissues. There are no discernable signs of diffusion of the amines from their cellular localizations. The methodology has been described and data on the specificity and sensitivity discussed. Applications of this method include the demonstration of catecholamines and 5-hydroxytryptamine in neurons and 5-hydroxytryptamine in mast cells (rat and mouse) and blood platelets.

1039

Gothenburg U. Dept. of Pharmacology (Sweden).

CELLULAR LOCALIZATION OF BRAIN MONOAMINES, by A. Carlsson, B. Falck, and N.-Å. Hillarp. [1962] [24]p. incl. illus. tables, refs. (AFOSR-4328) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-61-44, Public Health Service, and Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 56: 8-26, 1962.

The cellular localization of brain monoamines has been studied with the use of a fluorescence method for histochemical demonstration of certain catecholamines and tryptamines in combination with a pharmacological approach. Mainly the hypothalamus and caudate nucleus of mouse and rat were examined. The following are the most important results. Noradrenaline in the hypothalamus shows a high accumulation in fine varicose fibres which are present almost everywhere but highly concentrated in a large area of the preoptic region, the supraoptic and paraventricular nuclei, and the periventricular nuclei in the anterior hypothalamus. There is good evidence that these fibres represent the terminal parts of axons forming synaptic contacts. Similar fibres are present also in other parts of the central nervous system, including the spinal cord. There is good evidence that the perikarya and processes of some nerve cells in the hypothalamus contain a catecholamine in low concentrations. There also good evidence that a catecholamine is accumulated in high concentration in the superficial zone of the median eminence. Some circumscribed and more or less continuous areas, including the amygdala, surrounding the anterior hypothalamus and preoptic region develop a fluorescence which seems to be due to the presence of a catecholamine, possibly both noradrenaline and dopamine. The caudate nucleus as a whole develops a fairly high fluorescence.

1040

Gothenburg U. Dept. of Pharmacology (Sweden).

ON THE USE OF STRONG EXCHANGE RESINS FOR DETERMINATION OF SMALL AMOUNTS OF CATECHOL AMINES, by J. Häggendal. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-4334) (AF EOAR-61-44) Unclassified

Also published in Scand. Jour. Clin. and Lab. Invest., v. 14: 537-544, 1962.

The aim of the present investigation was to utilize strong cation exchange resin for the complete separation of the following catechol amines and metabolites: noradrenaline, adrenaline, normetanephrine, metanephrine, and dopamine. Destruction of the catechol amines on the columns of the strong cation exchange resin took place. Furthermore, the resin was found to give off interfering fluorescent material.

1041

Gothenburg U. Dept. of Pharmacology (Sweden).

FLUORIMETRIC DETERMINATION OF 3-O METHYLATED DERIVATIVES OF ADRENALINE AND NORADRENALINE IN TISSUES AND BODY FLUIDS, by J. Häggendal. [1962] [9]p. incl. diagrs. tables. (AFOSR-J494) (AF EOAR-61-44) AD 407859 Unclassified

Also published in Acta Physiol. Scand., v. 56: 258-266, 1962.

A method for the determination of small amounts of metanephrine and normetanephrine in tissues and body fluids is described. The disturbing effect of adrenaline noradrenaline is eliminated in 2 alternative ways: (1) by differential oxidation and subsequent ion exchange chromatography and (2) by separation on an ion exchange column. Metanephrine and normetanephrine are determined in the eluate from the ion exchange column according to the principles of the trihydroxyindole method for the fluorimetric determination of adrenaline and noradrenaline. Applications of the method on urine and brain tissue extracts are described. (Contractor's abstract)

1042

Gothenburg U. Dept. of Statistics (Sweden).

TABLES OF NORMAL AND LOG NORMAL RANDOM DEVIATES, PART I, by H. Hyrenius and R. Gustafsson. 1962, 83p. incl. diagrs. tables. (AFOSR-3179, pt. 1) (AF 61(052)459) AD 282196 Unclassified

The construction of random deviates from existing tables of random digits opened up the possibility of elucidating many statistical problems in cases where exact solutions cannot be obtained. For the purpose of deriving deviates of non-normal distribution two distributions seem to be of special interest, namely the type-III distribution and the logarithmico-normal. In smaller series the former seemed to produce strong disturbances due to the extreme deviates. As a result it was decided to concentrate on the logarithmico-normal distribution. In this respect the following are covered: Transformation of normal deviates to log-normal deviates; Derivation of distribution-corrected normal deviates in series of different size; Randomization of series; Comments on derived series of distribution-corrected random normal deviates; and Derivation of series of random log-normal deviates.

1043

Gothenburg U. Dept. of Statistics (Sweden).

TABLES OF NORMAL AND LOG NORMAL RANDOM DEVIATES. PART II, by H. Hyrenius and R. Gustafsson. 1962, 109p. incl. tables. (AFOSR-3179) pt. 2) (AF 61(052)459) AD 282195 Unclassified

This second part of the Tables of Normal and Log-Normal Random Deviates contains 5 sets of 10,000 deviates each, namely 1 series of 10,000 distribution-corrected random normal deviates and 4 transforms to log-normal deviates. All the 5 sets have the mean = 0 and the variance = 1; the log-normal sets have the skewness γ_1 = 0.2, 0.5, 1.0 and 2.0 respectively.

(Contractor's abstract)

1044

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

AIR VEHICLE FLIGHT PATH OPTIMIZATION. VOL. I OF II, by H. J. Kelley, M Falco, and D. J. Ball. Feb. 1962 [57]p. incl. diagrs. tables. (AFOSR/DRA-62-4, (AFOSR-2267, v. 1) (AF 29(600)2671) Unclassified

The analytical development of gradient techniques for air vehicle optimal performance calculations is attempted. The method of gradients, a direct variational procedure, is applied to the optimization of vehicle attitude and throttle programs which extremize the fuel, range, and time performance of air-breathing vehicles. The inequality constraint on thrust $0 \leq T \leq T_{Max}$ is treated by introduction of an appropriate throttle variable having limited variation and by a corresponding modification of the gradient process. A "penalty function" concept for convenient handling of certain types of constraints is presented. An integral form of the penalty function is introduced for use with 2 limit boundaries in the altitude-Mach number chart: one a minimum altitude limit and the second a Mach number-Altitude envelope imposed by powerplant and structural limitations. Another form of the penalty function is employed in connection with specified terminal conditions on the state variables. A run termination criterion sufficiently flexible for use in a large variety of problems is developed on the basis of a one-dimensional search for optimal terminal time performed concurrently with trajectory integration. Maximum range climb profiles for a hypothetical Mach 3 turbojet vehicle operating at full throttle are presented. (Contractor's abstract, modified)

1045

Grumman Aircraft Engineering Corp. Bethpage, N. Y.

AIR VEHICLE FLIGHT PATH OPTIMIZATION. DETAILS OF COMPUTER PROGRAM. VOL. II OF II, by H. J. Kelley, M. Falco, and D. J. Ball. Feb. 1962 [187]p. incl. diagrs. tables. (AFOSR/DRA-62-4) (AFOSR-2267, v. 2) (AF 29(600)2671) AD 272318 Unclassified

In the course of development of a digital computation technique for calculations of minimum fuel, max range, and minimum time air vehicle flight paths, 2 computer programs emerged. In both programs 2 control variables, vehicle attitude and throttle, are utilized to shape the successive approximations to the optimal path. This first program employs a penalty function procedure to move in the direction of steepest descent of a modified performance quantity to be minimized. The second employs alternating cycles of this penalty technique and projection in the negative direction of gradient of the performance quantity. An analysis of computer time and storage requirements for both double control programs led to a recommendation that a 32K core EDPM be employed. The double control variable programs are written in FORTRAN language for operation on the 32K type machine. A double control variable version of the penalty function scheme is described in FORTRAN for operation with 8K core type computers.

1046

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

TOPICS IN OPTIMIZATION THEORY, by H. J. Kelley, H. G. Moyer and others. Final rept. June 1962, 118p. incl. diagrs. refs. (Rept. no. RE-159) (AFOSR-4322) (AF 29(600)2733) AD 293940 Unclassified

Practical trajectory optimization problems are usually so complex as to require numerical rather than analytical approaches to solution. Consequently, it was necessary to grant first priority and a great deal of effort to means for computing optimal trajectories which satisfy prescribed boundary conditions. This was pursued primarily along the lines of the indirect method, the inference of a solution from the first 3 conditions of the classical theory, and by direct methods, mainly successive approximations. Relatively little was done in applying the necessary conditions associated with the second variation or in determining the characteristics of families of optimal trajectories, or fields of extremals, to employ variational terminology. These matters are of interest not only in ensuring selection of a truly optimal trajectory for operational use but are of primary interest in connection with the problem of guidance. A number of loosely connected studies in this general area is presented. (Contractor's abstract)

1047

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

GUIDANCE THEORY AND EXTERNAL FIELDS, by H. J. Kelley. [1962] [8]p. incl. diagrs. refs. (AFOSR-J358) (AF 29(600)2733) AD 408032 Unclassified

Presented at Nat'l. Aerospace Electronics Conf., Dayton, Ohio, May 14-16, 1962.

Also published in I. R. E. Trans. on Automatic Control, v. AC-7, 75-82, Oct. 1962.

A guidance concept employing properties of optimal flight paths is developed on the basis of Jacobi's accessory minimum problem for the second variation. The

analysis is equivalent to construction of a field of extremals in the neighborhood of a predetermined extremal serving as a nominal trajectory. In the absence of inequality constraints on the control variables, a linear terminal control scheme with time-varying gains is realized. The addition of inequality constraints leads to nonlinear control behavior. Certain propulsion system parameters are characterized as state variables as a convenient means for providing adaptive behavior in respect to in-flight changes in propulsion system performance. An application is given to an intercept problem sufficiently simple to allow analytical solution, and some numerical results comparing optimal and approximately optimal guidance in their effects on flight performance are presented. Treatment of a certain type of problem arising in rocket applications is discussed. (Contractor's abstract)

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

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

Gustaf Werner Inst. of Nuclear Chemis 'Sweden).
see Uppsala U. Gustaf Werner Inst. uclear Chemistry (Sweden).

Hamilton Coll., Ont. (Canada).
see McMaster U. Hamilton Coll., Ont. (Canada).

1048

Harvard U. Cruft Lab., Cambridge, Mass.

ON STOCHASTIC APPROXIMATION METHOD AND OPTIMAL FILTERING THEORY, by Y.-C. Ho. Oct. 25, 1962, 5p. (Technical rept. no. 387) (AFOSR-J612) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616 and Rand Corp.) AD 400128 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 6: 152-154, Feb. 1963.

The purpose of this report is to establish some connections among the maximum likelihood estimate, the optimal filtering and the stochastic approximation solutions to the following well-known problem. Consider the vector-matrix equations: $Ax + v_k = b_k$, $k = 1, 2, \ldots$, where A is a given rxn matrix, x is an unknown n-vector, v_k is a random r-vector with $E(v_k) = 0$, and $E(v_k v_j') = I\delta(k - j)$, and b_k is an r-vector of observation. One wishes to determine an estimate x for the unknown parameter x which is optimal in some sense. The author shows that a recursive technique for computing the maximum likelihood estimate of x is, for large values of k, equivalent to a multidimensional stochastic approximation method.

1049

Harvard U. Cruft Lab., Cambridge, Mass.

NONLINEAR OPTICAL PROPERTIES OF SOLIDS: ENERGY CONSIDERATIONS, by P. S. Pershan. Nov. 14, 1962 [38]p. incl. diagrs. tables, refs. (Technical rept. no. 393) (AFOSR-J1614) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 295762 Unclassified

Also published in Phys. Rev., v. 130: 919-929, May 1, 1963.

It is shown that the interaction between macroscopic, non-dissipative media, and time-varying electromagnetic fields can be described by a time-averaged potential function. From this function it is possible to derive phenomenologically the tensors that describe any of the usual electro- and magneto-optic effects for electric and magnetic fields of any frequency. In addition, these same potential functions describe the various optical nonlinearities like harmonic generation in KDP (potassium dihydrogen phosphate), and harmonic generation by electric quadrupole and magnetic dipole nonlinearities. The symmetry relations first derived by Armstrong, Bloembergen, Ducuing, and Pershan for electric dipole nonlinearities follow directly from the methods presented. In addition, analogous relations for electric quadrupole and magnetic dipole nonlinearities can be derived. These relations also demonstrate the reciprocal nature of the linear electro-optic effect and rectification of light. The Faraday effect and the production of a dc magnetization due to incident circularly polarized light are also reciprocal effects.

1050

Harvard U. [Cruft Lab.] Cambridge, Mass.

SPIN-LATTICE RELAXATION OF PARAMAGNETIC IONS IN DIAMAGNETIC GARNETS, by L. Svare and G. Seidel. [1962] [9]p. incl. diagrs. table. (AFOSR-64-2326) [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616] Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 430-438, 1963.

The spin-lattice relaxation time T_1, of several different paramagnetic rare earth ions having a 1% concentration in a variety of diamagnetic garnets has been measured at 9 kmc/sec between 1.2° and 77°K. As expected, T_1 is inversely proportional to T at the lowest temperatures where the direct, single phonon process is the main mechanism by which the spins are coupled to the lattice. At higher temperatures, T_1 varies more rapidly with T, and in some cases $T_1 \sim e^{\Delta/kT}$ indicating that the relaxation is predominately by a process involving 2 phonons in resonance with the first excited state. By observing the temperature dependence of T_1, it has been possible to determine the energy splitting of the first excited state of Er^{3+} and Dy^{3+} in a number of garnets. In other cases, evidence is found for relaxation via impurities, and the exponential temperature dependence is masked. The measure T_1 of Yb^{3+} is anomalously short in view of the known position of the first excited state. (Contractor's abstract)

1051

Harvard U. [Cruft Lab.] Cambridge, Mass.

TEMPERATURE DEPENDENCE OF PARAMAGNETIC RESONANCE LINES, by G. Seidel and L. Svare. [1962] [14]p. incl. diagrs. refs. (AFOSR-64-2327) (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616]) Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 468-481, 1963.

Paramagnetic resonance measurements are usually performed at temperatures where the various energy levels giving rise to the absorption have only a small separation as compared to the thermal energy.

However, a new type of phenomenon, which is dependent upon spin-spin interactions, manifests itself at sufficiently low temperatures where there is an appreciable variation of the average occupation numbers of the energy levels of the absorbing system. Recently, McMillan and Opechowski have pointed out that while the Van Vleck moment calculation is a high temperature approximation in that equal occupation of the energy levels is assumed, when $h\nu \gtrsim kT$, the moments of paramagnetic resonance lines may have a significant temperature dependence. Measurements have been performed on several crystals at 30 kmc/sec down to 0.3°K. In certain favorable cases, it is possible to deduce not only the magnitude but also the sign of the exchange interactions. This paper is devoted to a discussion of the observation and significance of these effects. (Contractor's abstract)

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Harvard U. [Cruft Lab.] Cambridge, Mass.

ELECTRIC SHIFT OF THE Cr^{3+} MAGNETIC RESONANCE IN RUBY, by N. Bloembergen and E. B. Royce. [1962] [13]p. incl. diagrs. table, refs. (AFOSR-64-2329) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186616]) Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 607-619, 1963.

The general phenomenological relationships and the basic physical mechanisms responsible for the occurrence of electrically induced shifts of paramagnetic resonance lines are given. The effects are illustrated in the case of C_3 symmetry for the Cr^{3+} ions in ruby. A linear splitting of the paramagnetic resonance lines is observed at about 14 kmc/sec, for several orientations of the electric and magnetic dc fields. The splitting corresponds to an equal and opposite shift of the Cr^{3+} spin levels at 2 sites related to each other by inversion. The complete angular dependence of this shift has been determined. It is described by additional terms in the spin Hamiltonian $\mathcal{H}_{E,S} = \Sigma \pm R_{ijk} E_i (S_j S_k + S_k S_j)$. The 5 independent non-vanishing coefficients of the third order R-tensor in C_3 symmetry have been measured and a qualitative interpretation in terms of crystal field structure is given. (Contractor's abstract)

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Harvard U. [Cruft Lab.] Cambridge, Mass.

ELECTRIC SHIFT OF THE F^{19} HYPERFINE INTERACTION IN ANTIFERROMAGNETIC MnF_2, by P. S. Pershan and N. Bloembergen. [1962] [9]p. incl. diagrs. refs. (AFOSR-64-2330) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186616]) Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 656-664, 1963.

Linear effects of an electric field on the hyperfine interaction of Mn^{++} 3d electrons with F^{19} nuclei are detected as shifts of the nuclear magnetic resonance frequency of the F^{19} nuclei. An electric field in the [110] direction shifts the resonant frequency for 2 F^{19} sites in the unit cell by ± 70 kc per sec/100 kv cm^{-1} and leaves the other 2 sites unaffected. This is a new parameter to be fitted by the theory for the F^{19} hyperfine interaction in MnF_2. With a combination of electric and magnetic fields, it is possible to investigate the presence of antiferromagnetic domain walls in MnF_2. In a crystal 1 mm x 4.8 mm x 7.9 mm with the [110] direction normal to the broad face, no evidence was found for domain walls. Signal to noise level limits the certainty with which one can say domain walls are completely absent. In these experiments, at least 80% of the crystal was of one domain. This situation has recently been confirmed by scattering of polarized neutron beams. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

CERTAIN RESULTS IN PULSE TRANSMISSION THEORY, by D. W. Tufts. Feb. 5, 1962 [52]p. incl. diagrs. refs. (Technical rept. no. 355) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 275564 Unclassified

Some results that pertain to the problem of controlling intersymbol interference and additive noise interference in a certain type of pulse transmission system are discussed. An amplitude modulated, periodic pulse train is the input to a noisy, linear, and time invariant transmission medium. At the receiver, the amplitude of each transmitted pulse is estimated by performing a weighted integration of the received waveform. A pulse code modulation link is a special case of such a system. Considering interference to be the mean square difference between a transmitted pulse amplitude and the receiver's estimate of this amplitude, an expression is derived for the minimum interference that is possible in the case of transmitted pulses of finite energy. An explicit method is also presented for specifying a transmitted pulse shape and a receiver weighting function which permit the minimum interference to be obtained. The ways in which the minimum interference is affected by the transmitted data rate, the type of transmission medium, the noise power density spectrum, and the transmitted pulse energy are explored and compared with previous results. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

COMPARISON OF DIFFERENT MODES OF REPRESENTATION OF MULTIVARIABLE SYSTEMS, by K. S. Narendra and L. E. McBride, Jr. Mar. 30, 1962, 41p. incl. diagrs. (Technical rept. no. 356) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 287039 Unclassified

A multivariable system may be conveniently represented either by a matrix of transfer functions or by a set of first-order differential equations. The mode of representation depends on the nature of the problem and the constraints involved. The relative merits of several methods as well as their inherent limitations are treated. Concepts such as controllability, observability, structure and interaction, which are peculiar to multivariable systems, are examined to form a basis for the comparison. (Contractor's abstract)

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Harvard U. [Cruft Lab.] Cambridge, Mass.

LIGHT HARMONICS AT THE BOUNDARY OF A NONLINEAR DIELECTRIC (Abstract), by N. Bloembergen and P. S. Pershan. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186615]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 259, Apr. 23, 1962.

The Fresnel formulas for the reflection and refraction of light are generalized to include nonlinearities of the dielectric medium. Harmonics appear both in the reflected and refracted waves, with distinct intensity and polarization characteristics. The theory predicts the phase shifts in the harmonics on reflection of the light beam going from vacuum to dielectric and vice versa, as well as the interference of harmonics in a nonlinear sheet. It is straightforward to generalize the results to anisotropic nonlinear dielectrics. In the case that 2 plane waves at frequencies ω_1 and ω_2 are incident on a plane boundary from different directions, sum and difference frequencies are created in directions which do not coincide, in general, with the directions of the reflected and refracted fundamental waves. If the nonlinear medium lacks an inversion center, the effects of atomic surface layers of width a are smaller than the boundary harmonics by a factor $(a/\lambda)^2$. The surface-layer effect is comparable in magnitude to electric-quadrupole and magnetic-dipole boundary harmonics in crystals with inversion center.

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Harvard U. Cruft Lab., Cambridge, Mass.

LIGHT WAVES AT THE BOUNDARY OF NONLINEAR MEDIA, by N. Bloembergen and P. S. Pershan. May 15, 1962, 5[illegible] incl. illus. refs. (Technical rept. no. 377) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 277658 Unclassified

Also published in Phys. Rev., v. 128: 606-622, Oct. 1962.

Solutions to Maxwell's equations in nonlinear dielectrics are presented which satisfy the boundary conditions at a plane interface between a linear and nonlinear medium. Harmonic waves emanate from the boundary. Generalizations of the well-known laws of reflection and refraction give the direction of the boundary harmonic waves. Their intensity and polarization conditions are described by generalizations of the Fresnel formulae. The equivalent Brewster angle for harmonic waves is derived. The various conditions for total reflection and transmission of boundary harmonics are discussed. The solution of the nonlinear plane parallel slab is presented which describes the harmonic generation in experimental situations. An integral equation formulation for wave propagation in nonlinear media is sketched. Implications of the nonlinear boundary theory for experimental systems and devices are pointed out. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

LINEAR STARK SPLITTING OF NUCLEAR SPIN LEVELS IN GaAs, by D. Gill and N. Bloembergen. [1962] [6]p. incl. illus. diagrs. table, refs. [Technical rept. no. 414] (Sponsored jointly by Advanced Research Projects Agency; Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 409539; AD 410418 Unclassified

Also published in Phys. Rev., v. 129: 2398-2403, Mar. 15, 1963.

A quadrupole splitting of the fourfold-degenerate nuclear spin levels of Ga^{69}, Ga^{71}, and As^{75} in a single crystal of GaAs has been induced by the application of a dc electric field along the [111] direction. The splitting of the nuclear magnetic resonance has been observed and the coupling constants R_{14} between the induced gradient tensor and the applied homogeneous electric field have been determined. The results are $R_{14}(Ga^{69}) = 1.05 \times 10^{10} cm^{-1}$, $R_{14}(Ga^{71}) = 0.9 \times 10^{10} cm^{-1}$, and $R_{14}(As^{75}) = 1.55 \times 10^{10} cm^{-1}$. A simple theoretical model explains the physical origin of this effect quite well. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

PARAMAGNETIC RESONANCE LINES AT LOW TEMPERATURE, by I. Svare and G. Seidel. Sept. 5, 1962 [178]p. incl. diagrs. tables, refs. (Technical rept. no. 378) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186816) AD 295897
Unclassified

A number of paramagnetic resonance lineshapes have been analyzed and explained in terms of spin-spin interaction. It is shown that this technique may be an important supplement to other methods of investigating interaction in paramagnetic salts. The advantages of the line moment method at low temperature are: (1) The exchange interaction can be found in sign and magnitude; possible anisotropy of the exchange can be detected; (2) Exchange interaction between unlike neighbors only can be measured; if the total exchange is known from other data, the exchange between like neighbors can be separated out; and (3) The method works best at rather weak interaction where specific heat and susceptibility experiments are difficult to perform with sufficient accuracy. The disadvantages of the method are: (1) A complex He^3 cryostat is needed and it is difficult to mount the sample inside the cavity in good heat contact with the He^3 reservoir; and (2) Spherical samples are needed to avoid demagnetizing effects; however, magnetostatic modes are easily excited in spheres, and this may obscure the true lineshape. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

RELAXATION TIME MEASUREMENTS IN RUBY BY A DC MAGNETIZATION TECHNIQUE, by S.-Y. Feng. June 1, 1962, 56p. incl. diagrs. refs. (Technical rept. no. 371) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 291503
Unclassified

A method of measuring the relaxation time of paramagnetic substances was developed. The change in the z-component of the magnetization was detected by a pick-up coil and the signal was amplified, integrated, and displayed on an oscilloscope. The method was much simpler than any of the other methods, and the reliability of data was, therefore, better. By this technique, the cross-relaxation and spin-lattice relaxation times were measured for ruby crystals. High-order cross-relaxation processes involving 3, 4, and 5 spins were observed, and the relaxation signal could be described fairly well by the solution of a set of rate equations appropriate to the particular process. Spin-lattice relaxation times were measured at different temperatures and concentrations. A Bloembergen-Pershan model, involving an inverted Orbach-Wolf mechanism, could satisfactorily explain the observed data. The dependence on concentration, magnetic field strength was also discussed. A qualitative explanation, due to Orbach, was given and the result was compared with the existing data. It seems that there is a mild field dependence, approximately linear with H, at high magnetic fields. (Contractor's abstract)

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Harvard U. [Cruft Lab.] Cambridge, Mass.

RELAXATION TIME MEASUREMENTS IN RUBY BY A DC MAGNETIZATION TECHNIQUE, by S.-Y. Feng and N. Bloembergen. [1962] [5]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 Phys. Rev., v. 130: 531-535, Apr. 15, 1963.

Relaxation time measurements by observation of the recovery of the z component of the dc magnetization have been carried out in ruby. Harmonic cross-relaxation processes, involving 2, 4, and 5 spins, have been identified. The cross-relaxation time for the 5-spin process is found to be proportional to $f^{-2.6}$, where f = Cr:Al atom ratio. The spin-lattice relaxation time is proportional to f^{-1} for small f, but decreases faster at higher concentrations. The temperature dependence as T^{-1} or T^{-2} can be explained by a model of cross relaxation between single ions and exchange coupled pairs. The magnetic field dependence is small.

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Harvard U. Cruft Lab., Cambridge, Mass.

A SELF ORGANIZING CONTROL SYSTEM BASED ON CORRELATION TECHNIQUES AND SELECTIVE REINFORCEMENT, by D. N. Streeter and K. S. Narendra. July 20, 1962 [54]p. incl. illus. diagrs. refs. (Technical rept. no. 359) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 291498
Unclassified

Control systems that exhibit a capacity to learn, in the sense of meaningful self-alteration based on experience are studied. The relation between learning, adaptation, and self-organization in control systems and in animals is discussed. A system capable of synthesizing its controllers without explicit knowledge of the process or the spectra of the inputs is described. The synthesis is based on the cross-correlation between a signal representing the desired output state and the various components of the tentative input signal. The system, in a general way, exemplifies the principles of learning used in programming a computer to play checkers. Results of computer simulation of the system are presented. The purpose is to present the motivation and the physical reasoning on which the system was based. Results of computer simulation of a self-organizing system are presented to demonstrate the feasibility of the design. (Contractor's abstract)

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Harvard U. [Cruft Lab.] Cambridge, Mass.

SUM RULES RELATING COHERENT X-RAY SCATTERING DATA TO THE DIAMAGNETIC NUCLEAR SHIELDING CONSTANT AND TO THE SELF-ENERGY OF THE CHARGE DISTRIBUTION OF THE SCATTERER, by J. N. Silverman and Y. Obata. [1962] [2]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616; and Atomic Energy Commission) Unclassified

Published in Jour. Chem. Phys., v. 38: 1254-1255, Mar. 1, 1963.

Two sum rules were derived. The sum rule relating coherent x-ray scattering to the diamagnetic shielding constant was applied to Br using the data of Hanson (Jour Chem. Phys., v. 36: 1046-1049, Feb. 15, 1962).

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Harvard U. Cruft Lab., Cambridge, Mass.

TRANSIENTS IN CYLINDRICAL ANTENNAS, by H. J. Schmitt. Jan. 5, 1959 [52]p. incl. illus. diagrs. refs. (Technical rept. no. 296) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186628) AD 216884 Unclassified

Transients in cylindrical antennas are investigated for the particular case of a step-function excitation. The transient response of the radiation field of a driven antenna and the induced transient voltage on a loaded receiving antenna are considered. The theoretical analysis makes use of Fourier's theorem to express the response as an integral over the response to all individual frequency components. The response as a function of time, obtained by graphical integration, shows rapid oscillations with a periodicity determined by the first resonance frequency of the antennas. Transient times are discussed in their relation to the bandwidth of the antenna. By proper loading of the dipole, transient times of the order of the time needed for a wave to travel along the dipole axis can be obtained. The response of a receiving antenna and the response of a transmitting antenna for any kind of excitation are shown to be connected by a differentiation or integration process. An experimental investigation is described in which the reception of a transient field due to a shock-excited distant transmitting antenna is observed. The measured results are in very good agreement with the theoretical prediction. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

ELECTROMAGNETIC FIELD PROBES, by H. Whiteside. Oct. 25, 1962 [251]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 377) (AFOSR-J1613) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 400131 Unclassified

The behavior of probes in the electromagnetic field is limited by the averaging of the measured field over the finite size of the probe. This is the major restriction on the use of the receiving dipole as an electric probe. The usual magnetic probe, a shielded loop, suffers in addition from a less well-known source of error. Such a loop, even for moderate size, will sustain currents that are proportional to the tangential electric field, not to the normal magnetic field as desired. These electric mode currents are studied in some detail, and methods of avoiding or reducing them are proposed and tested. In addition, the behavior of loop probes is studied in general, both theoretically and experimentally, varying all the relevant parameters such as loop size, shape, wire size, and load. (Contractor's abstract, modified)

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Harvard U. Cruft Lab., Cambridge, Mass.

HIGH-FREQUENCY DIFFRACTION OF CYLINDRICAL WAVES BY AN INFINITE SLIT IN A PLANE SCREEN, by C. L. Tang. Jan. 21, 1959 [19]p. incl. diagrs. tables. (Technical rept. no. 297) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 214980 Unclassified

The scattering of a cylindrical wave of wave number k by an infinite slit of width 2a, in a plane acoustically soft screen of zero thickness and infinite extent is considered. The line source is assumed to be at a distance from the center of the slit comparable to or greater than the width of the slit. In the limit of large ka, the transmission coefficient is found up to the order $(ka)^{-5/2}$. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

AN ASYMPTOTIC SOLUTION OF DIPOLES IN A CONDUCTING MEDIUM, by K. Sivaprasad. Jan. 25, 1962 [23]p. incl. diagrs. (Technical rept. no. 354) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 275331 Unclassified

A dipole located in a semi-infinite dissipative medium is treated. A new technique was applied to the Sommerfeld integrals based on a method suggested by Lighthill for asymptotic solutions of Fourier integrals. The advantages of the method are its simplicity and ease. The results are valid for far fields in both air and the conducting medium. (Contractor's abstract, modified)

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Harvard U. Cruft Lab., Cambridge, Mass.

DIFFRACTION BY A CIRCULAR APERTURE IN A UNIDIRECTIONALLY CONDUCTING SCREEN, by S. R. Seshadri and T. T. Wu. Apr. 10, 1962 [32]p. incl. diagrs. (Technical rept. no. 360) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 275334 Unclassified

The diffraction of a normally incident plane electromagnetic wave with wave number k by a circular aperture of radius a in an unidirectionally conducting plane screen of zero thickness and infinite extent is considered. In the limit of large ka, the ratio of the transmission cross section to the geometrical optics value πa^2 is found up to the order $(ka)^{-3/2}$. A new feature of this problem is that a set of rays in the sense of Keller's geometrical theory of diffraction emanates from the regions of the aperture rim to which the current on the screen is nearly tangential and proceeds in all directions. However, for the case of normal incidence, these rays do not contribute to the transmission cross section up to the order $(ka)^{-3/2}$. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

EXCITATION OF PLASMA WAVES IN AN UNBOUNDED HOMOGENEOUS PLASMA BY A LINE SOURCE, by S. R. Seshadri. July 23, 1962 [37]p. incl. diagrs. (Technical rept. no. 373) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 283830 Unclassified

The radiation characteristics of a line source of magnetic current embedded in a homogeneous electron plasma of infinite extent are investigated for the case in which a uniform magnetic field is impressed externally throughout the medium in the direction of the source. The single-fluid theory of magnetohydrodynamics is employed. A very simple model is assumed for the plasmas. Under this assumption, it is found that there are 2 modes of propagation of waves of small amplitude. By examining the behavior of these modes in the limiting cases of vanishing external magnetic field or infinite source frequency, they are identifiable as the modified forms of the usual plasma and optical modes which exist in an isotropic electron plasma. The dispersion relations for these 2 modes are discussed. The power radiated in each of the 2 modes is also evaluated. It is found that the power radiated in the optical mode is always lower than that due to the line source in free space, whereas the power radiated in the plasma mode is higher than that value for certain ranges of the source frequency. (Contractor's abstract)

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Harvard U. Cruft Lat., Cambridge, Mass.

EXCITATION OF SURFACE WAVES ON A PERFECTLY CONDUCTING SCREEN COVERED WITH ANISOTROPIC PLASMA, by S. R. Seshadri. May 7, 1962 [24]p. incl. diagrs. (Technical rept. no. 366) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 282293 Unclassified

The field due to a line source of magnetic current situated in a lossless plasma region above a perfectly conducting screen is considered when a uniform static magnetic field is impressed throughout the plasma region parallel to the direction of the line source. It is shown that under certain conditions surface waves are excited on the screen. The dependence of the efficiency of excitation of surface waves on the distance d of the line source from the ground screen is examined. Also, the asymptotic series for the radiation field is derived, and its leading term is shown to vanish for a particular value of d. Under these conditions, a strong surface-wave field is maintained near the guiding surface. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

EXCITATION OF SURFACE WAVES ON A UNIDIRECTIONALLY CONDUCTING SCREEN, by S. R. Seshadri. Jan. 15, 1962 [25]p. incl. diagrs. (Technical rept. no. 344) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 272080 Unclassified

Also published in I. R. E. Trans. on Microwave Theory and Tech., v. MTT-10: 279-286, July 1962.

The excitation of plane surface waves by a line source on a unidirectionally conducting infinite and semi-infinite screen is considered. The condition for the existence of the surface wave and the optimum location of the line source for obtaining the highest efficiency of excitation are determined. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

IMPEDANCES AND ADMITTANCES OF LONG ANTENNAS IN AIR AND IN DISSIPATIVE MEDIA WITH TABLES OF THE FUNCTIONS $f(p) \pm ig(p) = 1 \pm ip$, by D. W. Gooch, C. W. Harrison, Jr. and others. Jan. 15, 1962 [176]p. incl. diagrs. tables, refs. (Technical rept. no. 353) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 283990 Unclassified

Tables and graphs are provided for the impedance and admittance of cylindrical dipole antennas center driven by a delta-function generator when immersed in air or

in a dissipative medium. The electrical half-length ranges from 1 to 100 for dipoles in air and from 1 to 19.7 for dipoles in a dissipative medium. Three ratios of radius of the antenna to wavelength in air have been used. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

INPUT ADMITTANCE OF INFINITELY LONG DIPOLE ANTENNAS DRIVEN FROM COAXIAL LINES, by T. T. Wu. Apr. 17, 1962 [11]p. incl. diagrs. (Technical rept. no. 362) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 277657 Unclassified

Also published in Jour. Math. Phys., v. 3: 1298-1301, Nov.-Dec. 1962.

For an infinitely long dipole antenna driven from a coaxial line, the reflection coefficient and hence the apparent terminal admittance are determined approximately when the radii of the coaxial line are small compared with the wavelength. This result is useful because the differences of admittances for antennas with identical geometry near the driving point are less sensitive to the driving condition and hence can be found approximately by many existing theories. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

INPUT ADMITTANCE OF LINEAR ANTENNAS DRIVEN FROM A COAXIAL LINE, by T. T. Wu. Mar. 15, 1962 [19]p. incl. diagrs. (Technical rept. no. 357) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 275332 Unclassified

In 2 cases of a linear antenna driven from a coaxial line, it is shown that the apparent terminal admittance to the coaxial line can be additively separated into 2 parts when the transverse dimensions are small compared with the wavelength. One of these 2 parts depends only on the wavelength and the dimensions of the antenna, while the other part can be interpreted as a capacitance that depends only on the radii of the coaxial line. This capacitance may be found exactly from the solution of an integral equation, in the sense that further corrections cannot be interpreted simply as a capacitance. (Contractor's abstract)

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Harvard U. [Cruft Lab.] Cambridge, Mass.

INTERACTIONS BETWEEN LIGHT WAVES IN A NONLINEAR DIELECTRIC, by J. A. Armstrong, N. Bloembergen and others. Mar. 20, 1962 [74]p. incl. diagrs. refs. (Technical rept. no. 358) (Sponsored jointly by Advanced Projects Research Agency; Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186632]) AD 275333 Unclassified

Also published in Phys. Rev., v. 127: 1918-1939, Sept. 15, 1962.

The induced nonlinear electric dipole and higher moments in an atomic system, irradiated simultaneously by 2 or 3 light waves, are calculated by quantum mechanical perturbation theory. Terms quadratic and cubic in the field amplitudes are included. An important permutation symmetry relation for the nonlinear polarizability is derived and its frequency dependence is discussed. The nonlinear microscopic properties are related to an effective macroscopic nonlinear polarization, which may be incorporated into Maxwell's equations for an infinite, homogeneous, anisotropic, nonlinear, dielectric medium. Energy and power relationships are derived for the nonlinear dielectric which correspond to the Manley-Rowe relations in the theory of parametric amplifiers. Explicit solutions are obtained for the coupled amplitude equations, which describe the interaction between a plane light wave and its second harmonic or the interaction between 3 plane electromagnetic waves, which satisfy the energy relationship $\omega_3 = \omega_1 + \omega_2$, and the approximate momentum relationship $k_3 = k_1 + k_2 + \Delta k$. Third-harmonic generation and interaction between more waves is mentioned. Applications of the theory to the dc and microwave Kerr effect, light modulation, harmonic generation, and parametric conversion are discussed. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

THE LONG, CYLINDRICAL ANTENNA: CURRENT AND ADMITTANCE, by K. Iizuka, R. W. P. King, and S. Prasad. Jan. 25, 1962 [43]p. incl. diagrs. refs. (Technical rept. no. 351) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 275563 Unclassified

A study was made of the long, cylindrical antenna. The driving-point admittance, the relative amplitude, and the phase distributions of the current are given for long cylindrical dipole antennas ranging in electrical half-length from $\beta h = 0.3$ to $\beta h = 63.1$, when driven by a 2-wire line. The measured values of the driving-point admittance are in good agreement with the King-Middleton second-order-theory for the shorter lengths of antennas and with Wu's theory for the longer lengths. Particular care was taken to determine the influence of an unbalanced feeding line on both the driving-point admittance and the current distribution on the antenna. The measured driving-point admittance of the long antenna was extrapolated to that of the infinite length. The current distributions on the halves of the antenna, when driven by symmetric currents (completely unbalanced line) and by anti-symmetric currents (balanced line), are compared. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

A METHOD OF MEASURING THE TIME-DEPENDENT IMPEDANCE OF THE LOAD, by K. Iizuka. Apr. 20, 1962 [17]p. incl. diagrs. table. (Technical rept. no. 364) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 282292 Unclassified

By processing a sequence of scope pictures of the output from the probe of a standing-wave detector placed successively at a sequence of positions along a slotted coaxial line, the instantaneous values of a nonstationary load impedance terminating a coaxial line may be measured. This method was applied to measure the instantaneous values of the impedance of a fast-response Cadmium Selenide photo-cell which has a rise and decay time of the order of milliseconds. The experiments were performed at 600 mc. The experimental results were satisfactory and a change that took place in a few milliseconds could easily be measured. On the other hand, a change that occurs in a few tenths of a microsecond would be near the present limit of measurement. This technique could be extended to the measurement of the dynamic impedance of a plasma tube during the rise and decay period of the plasma intensity, or to the measurement of dynamic conductivities, or electric and magnetic susceptibilities in general. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

A NEW TECHNIQUE FOR MEASURING AN ELECTROMAGNETIC FIELD BY A COIL SPRING, by K. Iizuka. June 19, 1962 [22]p. incl. diagrs. table, refs. (Technical rept. no. 365) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 287037 Unclassified

Also published in I. E. E. E. Trans. on Microwave Theory and Techniques, v. MTT-11: 496-505, Nov. 1963.

A thin coil spring whose length can be varied periodically by mechanical means was used as a probe to measure the electric field intensity. The vibrating probe acts as a re-radiating antenna with periodically varying length that modulates and scatters the component of the E field which is parallel to the axis of the spring. The scattered signal is picked up by a receiving antenna (the sending antenna was used also as a receiving antenna) and amplified with an amplifier that is locked-in with the frequency of the mechanical vibration of the coil. Measurements were made with coil springs of 3 different dimensions, and a gain constant K, which should be independent of the product of the axial length of the coil and the magnitude of the vibration, was experimentally checked. Measurements of the field of a half-wave dipole antenna as measured with the spring probe are in general agreement with theory. An expression for the gain of the system is obtained based upon the field-pattern method, and the approximations involved in the reciprocity-theorem method are clarified. It is also demonstrated that the effective length of a thin helical antenna equals the axial length of the helix. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

PERTURBATION THEORY OF PION-PION INTERACTION II: TWO-PION APPROXIMATION, by T. T. Wu. Jan. 15, 1962 [27]p. incl. diagrs. (Technical rept. no. 348) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 272358 Unclassified

Also published in Phys. Rev., v. 126: 2219-2226, June 1962.

On the basis of the model of a 4-particle direct interaction without derivative coupling, relations are obtained between the various renormalized quantities related to pion-pion interaction. By considering only 2-pion intermediate states but preserving crossing symmetry and unitarity up to the production threshold, closed systems of nonlinear integral equations are obtained from these relations to describe approximately the low-energy pion-pion scattering. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

A PHOTOCONDUCTIVE PROBE FOR MEASURING ELECTROMAGNETIC FIELDS, by K. Iizuka. July 25, 1962 [31]p. incl. illus. diagrs. refs. (Technical rept. no. 374) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 287035 Unclassified

Also published in Proc. Inst. Elec. Engineers (London), v. 110: 1747-1754, Oct. 1963.

Probes were constructed for measuring the intensity of the electromagnetic field in which the usual connecting leads between the probe and the detector are eliminated. The new devices are modulated reradiating or scattering antennas that consist of either a small dipole (for measuring E) or a small shielded loop (for measuring H) center-loaded with a photo cell illuminated by a chopped beam of light. The modulated scattered signal from the probe is proportional to either the component of the E field which is parallel to the axis of the dipole, or to the component of the H field which is perpendicular to the plane of the shielded loop. The scattered signal is received by an additional antenna or by the same antenna as is used for transmission. The received signal is amplified by a lock-in amplifier. The same principle was applied to the measurement of the distribution of current along an antenna with arbitrary shape. Both the near-field pattern of a half-wave dipole

antenna and the distribution of current along the antenna as measured with those optical probes are in general agreement with the theory. The properties of several other types of probes based on the same principle were also explored. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

RADIATION FROM A LINE SOURCE IN A UNIAXIALLY ANISOTROPIC PLASMA, by H. S. Tuan and S. R. Seshadri. Aug. 25, 1962 [20]p. incl. diagrs. (Technical rept. no. 375) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186332) AD 287036
Unclassified

Also published in Canad. Jour. Phys., v. 41: 246-257, Feb. 1963.

Two problems of radiation in a magnetized, incompressible plasma are investigated. The radiation characteristics of a line source of magnetic current are studied for the case in which the external magnetic field is infinite and is oriented in a direction perpendicular to that of the source. The second problem that is treated is the radiation from a uniformly moving line charge. Two cases are considered: (1) when the motion of the line charge is parallel and (2) when it is perpendicular to the direction of the external magnetic field. In each case it is found that there is a Cerenkov-type radiation for frequencies less than the plasma frequency. The frequency and the angular spectrum, as well as the total energy radiated per unit path length, are determined for both cases. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

RADIATION FROM A UNIFORMLY MOVING CHARGE IN AN ANISOTROPIC PLASMA, by H. S. Tuan and S. R. Seshadri. Dec. 26, 1962 [39]p. incl. diagrs. (Technical rept. no. 389) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 299998
Unclassified

Also published in I. E. E. E. Trans. on Microwave Theory and Techniques, v. MTT-11: 462-471, Nov. 1963.

The radiation from a point charge moving uniformly in a plasma is investigated when the charge is moving in the direction of an external magnetic field. In general, there are 2 modes, for each of which all the components of the electric and magnetic field are present. The 2 parameters of interest in this problem are the ratio u/c_0 of the velocity of the charges to the free-space velocity of electromagnetic waves and the ratio R of the gyromagnetic frequency to the plasma frequency of the electrons. For 2 sets of values of these parameters, the frequency and the angular spectrum of the emitted radiation are obtained. In certain cases, as many as 3 Cerenkov rays are found to propagate in the same direction; these multiple rays, however, correspond to different modes of propagation. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

SCATTERING BY A NARROW PERFECTLY CONDUCTING INFINITE STRIP IN A GYROTROPIC MEDIUM, by S. R. Seshadri. Oct. 25, 1962, 11p. (Technical rept. no. 380) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 291752 Unclassified

Also published in I. E. E. E. Trans. on Antennas and Prop., v. AP-11: 570-573, Sept. 1963.

The scattering of a plane electromagnetic wave of wavenumber k by a perfectly conducting infinite strip of width 2^a is investigated for the case in which the surrounding medium is gyrotropic. The gyrotropic axis is taken parallel to the edges of the strip. The problem is formulated in terms of an integral equation whose solution is obtained in the form of a series in powers of ka. Expressions for the far-zone fields and the first 2 terms in the series for the total scattering cross section are obtained. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

SCATTERING BY DISCONTINUITIES OF SURFACE WAVES ON A UNIDIRECTIONALLY CONDUCTING SCREEN, by S. R. Seshadri. Jan. 15, 1962 [31]p. incl. diagrs. (Technical rept. no. 349) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 274142
Unclassified

The propagation of electromagnetic waves in waveguides with anisotropic walls has in recent years assumed practical importance in long-distance waveguide communication. It is shown that an anisotropic planar surface can support a guided wave which is attenuated exponentially in the direction normal to the surface. The spread of the field in this surface waveguide decreases as the angle between the direction of propagation and the direction of the wires becomes close to $\pi/2$. Appropriate boundary conditions applicable at the surface of such a unidirectionally conducting screen are given. Radiation from the open end of such a semi-infinite surface waveguide is treated. The electromagnetic fields produced at the junction of 2 semi-infinite surface waveguides are examined; the wires composing the 2 surface waveguides are assumed to be in different directions. A treatment is given for the problem of radiation from the junction formed by a semi-infinite surface waveguide and a perfectly conducting half-plane.

For this case, the power reflection coefficient and the radiation pattern are found to be the same as for the open-ended waveguide. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

THE SMALL LOOP ANTENNA IMMERSED IN A DISSIPATIVE MEDIUM, by C.-L. Chen. May 20, 1962 [7]p. incl. diagr. (Technical rept. no. 369) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 283827 Unclassified

The problem of a thin loop antenna in free space has been studied extensively by Storer. The Hallin integral equation for the current is solved by means of a Fourier Series. The problem considered in this report as the input admittance of a small thin-wire loop antenna immersed in a dissipative medium. The following equation is derived: input admittance $= Y_{in} = \frac{I(o)}{V} =$

$$-J\frac{\ell_o}{\gamma_e}\,\frac{1}{120\pi^2}\,\frac{1}{8b}\left[\frac{1}{k_1}+\frac{4}{k_0+k_2-\frac{2}{(kb)^2}\,k_1}\right].$$

1086

Harvard U. Cruft Lab., Cambridge, Mass.

TERMINAL ZONE CORRECTIONS FOR A DIPOLE DRIVEN BY A TWO-WIRE LINE, by K. Iizuka and R. W. P. King. Feb. 25, 1962 [23]p. incl. diagrs. tables, refs. (Technical rept. no. 352) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 277663 Unclassified

The terminal-zone effects on the dipole antenna driven by a 2-wire transmission line have been re-examined. A series inductive correction together with other terminal-zone corrections is found necessary to reduce the measured apparent admittance of the antenna terminating the 2-wire line with the ideal admittance of the dipole antenna when driven by a delta-function generator. The series inductive correction takes account of the absence of the antenna wire in the gap between the 2-wires of the transmission line. With this additional correction, the measured apparent admittance of a dipole antenna may be brought into excellent agreement with theoretical values and also reconciled with the quite different values measured with a coaxial line for an antenna consisting of the vertical inner conductor of the line extended over a horizontal ground plane. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

THEORY OF THE THIN CIRCULAR LOOP ANTENNA, by T. T. Wu. Apr. 16, 1962 [10]p. incl. diagrs. (Technical rept. no. 361) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632, and National Science Foundation) AD 277656 Unclassified

Also published in Jour. Math. Phys., v. 3: 1301-1304, Nov.-Dec. 1962.

The current distribution on a thin circular loop transmitting antenna driven by a delta-function generator is determined approximately by Fourier series expansion. A difficulty encountered in previous analysis is shown to be due to an inadequate approximation. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

TRANSIENT RESPONSE OF LINEAR ANTENNAS DRIVEN FROM A COAXIAL LINE, by T. T. Wu and R. W. P. King. May 25, 1962 [26]p. incl. diagrs. (Technical rept. no. 370) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 287038 Unclassified

The initial transient response of straight wires connected to coaxial lines is studied theoretically for the case where a pulse is applied to the coaxial line. The wave form of the return pulse is first found approximately for the case of a pulse of zero rise time. Since this does not correspond to any feasible experimental situation, the effect of a finite rise time is considered in detail. Numerical results are obtained for several special cases. (Contractor's abstract)

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Harvard U. Dept. of Chemistry, Cambridge, Mass.

CASIMIDINE, A FRAGMENT OF CASIMIROEDINE CONTAINING β-GLUCOSE AND N-METHYLHISTAMINE, by S. Raman, J. Reddy and W. N. Lipscomb. [1962] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)809 and National Institutes of Health) Unclassified

Published in Acta Cryst., v. 16: 364-369, Apr. 10, 1963.

The molecular and crystal structure of the dihydrochloride of the alkaloid casimidine has been elucidated. A β-glucose residue is established and is shown to the point of attachment of the $CH_2CH_2NHCH_3$ group of N-methylhistamine. The H-bonding scheme suggests that the other 2 N atoms of the dihydrochloride ($C_{12}H_{21}N_3O_5 \cdot 2HCl$) are protonated. There are 4 formula weights in a unit cell of dimensions a = 27.81, b = 10.76 and c = 5.76 A, and the space group is $P2_12_12_1$. The final value of $R = \Sigma||F_o|-|F_c||/\Sigma|F_o|$ is 0.12 for the 1036 observed reflections. (Contractor's abstract)

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Harvard U. Dept. of Chemistry, Cambridge, Mass.

STRUCTURE OF $Cu_2B_{10}H_{10}$, by R. D. Dobrott and W. N. Lipscomb. [1962] [6]p. incl. diagrs. tables, refs (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)809] and National Institutes of Health) Unclassified

Published in Jour. Chem. Phys., v. 37: 1779-1784, Oct. 15, 1962.

An x-ray diffraction study of the crystal structure of $Cu_2B_{10}H_{10}$ shows that the earlier proposal that the $B_{10}H_{10}^{-2}$ ion has D_{4d} symmetry is correct, and further establishes the covalent nature of the interactions of Cu^I with B atoms forming the edges of the polyhedron. There are 8 $Cu_2B_{10}H_{10}$ in a unit cell having dimensions a = 10.11, b = 11.36, and c = 14.50, and the space group is Pcab. Bonds within a tetragonal pyramid are 1.73 A (to apex) and 1.86 A (along base), while B-B bonds between the tetragonal pyramids are 1.81 A in length. The closest Cu···B distances range from 2.14 to 2.33 A in length.

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Harvard U. Dept. of Chemistry, Cambridge, Mass.

STRUCTURE OF THE ALKALOID CASIMIROEDINE, by S. Raman, J. Reddy and others. [1962] [4]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)809] and National Institutes of Health) Unclassified

Published in Tetrahedron Ltrs., No 9: 357-360, May 1962.

Casimidine (I) was acetylated with Ac_2O-C_5H_5N at 25° and cleaved for 1.5 hr at 40° in 40% aqueous HBr-AcOH-CH_2Cl_2. The bromo sugar was extracted with CH_2Cl_2, and hydrolyzed with Ag_2CO_3. Acetylation of the crude product and chromatography yielded 28% β-D-glucose pentaacetate, mp 130-131°, $[\alpha]_D^{25}$ +3° ($CHCl_3$). The result suggested the presence of an N-glycosidic linkage and showed that casimiroedine (I) is one of a number of possible N-D-glucosides of N-cinnamoyl-N-methylhistamine in which the configuration of the anomeric center, the size of the sugar ring, and the N atom linked to the sugar are indeterminate. Crystallographic examination of I.2HCl established the glucose residue, except for absolute configuration, and further showed that β-glucose (all 5 ring H atoms in the axial configuration) is attached by equatorial bond to the histamine ring at the N atom further from the CH_2CH_2NHMe group. I.2HCl has space group $P2_12_12_1$ and unit cell dimensions a = 27.81, b = 10.76, and c = 5.76A. The available organic chemistry and x-ray evidence complete the structure of II except for the question of trans or cis configuration of the cinnamoyl group.

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Harvard U. [Dept. of Chemistry] Cambridge, Mass.

THEORY OF POLYHEDRAL MOLECULES. III. POPULATION ANALYSES AND REACTIVITIES FOR THE CARBORANES, by R. Hoffmann and W. N. Lipscomb. [1962] [5]p. incl. diagrs. tables (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)809] Office of Naval Research, and Public Health Service) Unclassified

Also published in Jour. Chem. Phys., v. 36: 3489-3493, June 15, 1962.

Population analyses of the molecular orbitals of the polyhedral carboranes, $B_{N-2}C_2H_N$, are computed. All the geometrical isomers of the trigonal, tetragonal, pentagonal bipyramid, and the icosahedron geometries are analyzed, and predictions were made of the reactivities of these compounds and their derivatives. A comparison is also made between an LCAO-MO charge distribution and that derived from the 3-center bond formalism. (Contractor's abstract)

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Harvard U. Dept. of Chemistry, Cambridge, Mass.

X-RAY STRUCTURE DETERMINATION OF $(CH_3)_2NSO_2N(CH_3)_2$ AND LCAO-MO STUDY OF MULTIPLE BONDING IN SULFONES, by T. Jordan, H. W. Smith and others. [1962] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)809] and National Institutes of Health) Unclassified

Published in Jour. Amer. Chem. Soc., v. 85: 846-851, Apr. 5, 1963.

The crystal and molecular structure of $(CH_3)_2NSO_2N(CH_3)_2$ has been solved, and the bonding in isoelectronic $F_2NSO_2NF_2$ has been investigated in LCAO-MO one-electron approximation, in order to provide a model for understanding the barrier to internal rotation observed in α-sulfonyl carbanions. The barrier is shown to arise from interactions involving the d-orbitals of S with the p-orbitals of bonded atoms.

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ANALYTIC MAPS BETWEEN RIEMANN SURFACES, by D. H. Hustmoller. [1961] [5]p. [AF 18(600)1461] Unclassified

Published in Proc. Amer. Math. Soc., v. 13: 412-416, June 1962.

Let X, Y be Riemann surfaces whose universal covering surfaces are unit disks, X^0, Y^0. If x_0y_0 [respectively, $0, 0$] are fixed in X, Y[X^0, Y^0] let A(X, Y) [A(X^0, Y^0)]

be the set of analytic maps from X into Y[X^0 into Y^0] which carry x_0 onto y_0[0 onto 0]. By a natural lifting A(X, Y) can be viewed as a subset of $A(X^0, Y^0)$. The author proves that A(X, Y) is a closed subset of $A(X^0, Y^0)$ where the latter is given the topology of uniform convergence on compact sets. In the proof, an approximation theorem is used which gives a criterion for $f_n \in A(W_n, Y)$ to converge to some $f \in A(X, Y)$, where $\{W_n\}$ is an increasing sequence of "simply embedded" subsurfaces of X. The criterion concerns the nature of the group homomorphisms induced by the (natural liftings of the) f_n. (Math. Rev. abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON SOME CONJECTURES CONCERNING FINITE SIMPLE GROUPS, by R. Brauer. [1962] [8]p. incl. refs. [AF 49(638)287] Unclassified

Published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szego, C. Loewner, and others. Stanford U. Press, 1962, p. 56-61.

Several interesting conjectures in the theory of finite groups are stated. Each of these conjectures is accompanied by several theorems which verify the truth of these conjectures in special cases. The proofs of most of these theorems are omitted. Conjecture (A): There exist only finitely many simple groups of G whose order g is divisible by exactly 3 distinct primes. Conjecture (B): Let G be a simple group or order $g = p^a q^b g_0$, where p and q are distinct primes (a > 0, b > 0) and where g_0 is an integer prime to p. Conjecture (C): If the order of a noncyclic simple finite group G is divisible by p^2, p a prime, then $g > p^{cp}$. The final conjecture, which is a modification of (A), is based on the observation that the order g of each type of known classical group of degree n over the finite field of m elements seems to have a factorization $g = p_{1^{a_1}} \cdots p_{r^{a_r}}$, where $p_1, \ldots p_r$ are integers so that the characters of the group G behave as though these factors were primes. Conjecture (A*): There exist only finitely many simple groups G whose order is divisible by exactly r distinct primes and which do not belong to a class of classical groups for which the number r does not exceed n. (Math. Rev. abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE SUPERABUNDANCE OF THE COMPLETE LINEAR SYSTEMS |ND| (N-LARGE) FOR AN ARBITRARY DIVISOR D ON AN ALGEBRAIC SURFACE, by O. Zariski. [1962] [17]p. (AFOSR-3313) (AF 49(638)-494) Unclassified

Also published in Atti Convegno Internazionale Geometria Algebrica, Torino (Italy) (1961), Turin, Rattero, 1962, p. 105-121.

For abstract see item no. 1097, Vol. VI.

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

THE THEOREM OF RIEMANN-ROCH FOR HIGH MULTIPLES OF AN EFFECTIVE DIVISOR ON AN ALGEBRAIC SURFACE, by O. Zariski and D. Mumford. [1962] [56]p. incl. refs. (AFOSR-3314) (AF 49(638)-494) Unclassified

Also published in Ann. Math., v. 76: 560-615, Nov. 1962.

Let F be a projective non-singular surface and let D be an effective divisor on F. The purpose of this paper is to determine the dimension of the complete linear system |nD| as a function of n for large values of n. In part I, the author treats the ring-theoretic aspect of the problem. Part II is devoted to the proof of some results concerning linear systems without base joints. Part III is devoted to the solution of the general problems. (Math Rev. abstract, modified)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

SOME FUNDAMENTAL LEMMAS ON PROJECTIVE SCHEMES, by Y. Nakai. [1962] [7]p. [AF 49(638)494] Unclassified

Published in Trans. Amer. Math. Soc., v. 109: 296-302, Nov. 1963.

Let X be a projective scheme over an infinite field k. Let $\mathcal{O}$ be the structure sheaf of X, and let $\mathcal{K}$ be the sheaf of total quotient rings of $\mathcal{O}$. Let $\mathcal{O}^*$ and $\mathcal{K}^*$ denote the sheaves of invertible elements of $\mathcal{O}$ and $\mathcal{K}$, respectively. Then the natural map $\delta: H^0(X, \mathcal{K}^*/\mathcal{O}^*) \to H^1(X, \mathcal{O}^*)$ deduced from the exact sequence $0 \to \mathcal{O}^* \to \mathcal{K}^* \to \mathcal{K}^*/\mathcal{O}^* \to 0$ is surjective. In other words, every invertible sheaf on X comes from a Cartier divisor class. If X is integral (i.e., irreducible and without nilpotent elements) one knows that $\mathcal{K}^*$ is a flasque sheaf, and so $H^1(X, \mathcal{K}^*) = 0$. This proof does not work in the general case, so the author shows directly that δ is surjective. For an example of a scheme X where $H^1(X, \mathcal{K}^*) \neq 0$, take the plane with two embedded points: X = Spec A, where $A = k[x, y, z]/(z^2, zx, zy(y - 1))$. (Math. Rev. abstract)

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Harvard U. Dept. of Mathematics, Cambridge, Mass.

THE ZEROS OF INFRAPOLYNOMIALS WITH

PRESCRIBED VALUES AT GIVEN POINTS, by J. L. Walsh and O. Shisha. [1962] [6]p. incl. refs. (AFOSR-3317) (AF 49(638)574) AD 453955 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 839-844, Oct. 1963.

Abstract published in Notices Amer. Math. Soc., v. 9: 315, 1962.

The concept of infrapolynomials with some prescribed coefficients (that is to say, with prescribed values of certain derivatives at the point z = 0) is generalized by prescribing values of the polynomial and of certain of its derivatives at given points $z_1, z_2, \ldots, z_k$, and the geometric location of its zeros in the complex plane is studied. (Contractor's abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

TEICHMÜLLER SPACES, by L. V. Ahlfors. [1962] [7]p. (AFOSR-3861) (AF 49(638)574) Unclassified

Also published in Proc. Internat'l. Cong. of Mathematicians, Stockholm (Sweden) (Aug. 15-22, 1962), Djursholm, Institut Mittag-Leffler, 1963, p. 3-9.

This paper deals with the application of Teichmüller spaces to Riemann's problem of moduli. (Math. Rev. abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

GEODESIC CURVATURE AND AREA, by L. V. Ahlfors. [1962] [7]p. (AFOSR-4673) (AF 49(638)574) AD 407866 Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szego, C. Loewner, and others. Stanford U. Press, 1962, p. 1-7.

When dealing with the conformal mapping of portions of a surface, one finds in general that the more negative the Gauss curvature, the more the surface will contract under conformal maps. A very precise form is given to this statement by showing that if one has a simply connected region with a conformal metric, then upper and lower bounds for its conformal radius can be obtained in terms of inequalities between the area and the total Gauss curvature of subregions. The method uses a comparison of area with total geodesic curvature which is equivalent to total Gauss curvature, by the Gauss-Bonnet formula, in a manner analogous to the author's previous applications of the length-area method. The method actually yields explicit expressions for the conformal radius as an extremum over the totality of conformal metrics on the region. (Math. Rev. abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

A NOTE ON THE KO-THEORY OF SPHERE-BUNDLES, by R. Bott. [1962] [6]p. (AFOSR-3968) (AF 49(638)-1035) Unclassified

Also published in Bull. Amer. Math. Soc., v. 68: 395-400, July 1962.

Two vector bundles E and F over the finite connected CW complex X are J-equivalent, if their sphere-bundles S(E) and S(F) are of the same fiber-homotopy type. If they become J-equivalent after a suitable number of trivial bundles is added to both of them, they are stably J-equivalent. This note concerns itself with a new stable J-invariant $\theta(E)$, which was suggested by the recent work of Atiyah-Hirzebruch and F. Adams. In fact, $\theta(E)$ bears the same relation to the Adams operation ψ_i as the Stiefel-Whitney class, a known J-invariant, bears to the Steenrod operations.

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Harvard U. Dept. of Mathematics, Cambridge, Mass.

LECTURES ON K(X), by R. Bott. [1962] [150]p. incl. diagrs. tables, refs. (AFOSR-3969) (AF 49(638)1035) Unclassified

The primary aim of these notes is to discuss a J-invariant of vector bundles $\theta(E)$, which is computable once the group of stable bundles over X, - that is K(X) - is known. The invariant $\theta(E)$ is clearly suggested by recent work. The guiding principle of these notes is then to construct the analogue of the theory of characteristic classes in the K-theory and as this analogue is much simpler in the KU-theory, it is discussed in the first 8 sections. The remainder of the report discusses such aspects as: (1) sphere-bundles, (2) Gysin sequence, (3) real projective bundles, (4) Thom isomorphism and (5) induced representations.

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

POLYNOMIALS OF BEST APPROXIMATION ON AN INTERVAL, II, by J. L. Walsh and T. S. Motzkin. [1962] [5]p. (AFOSR-J27) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-198 and Office of Naval Research) AD 629538 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1533-1537, Sept. 1962.

The purpose of this note is to prove the following theorem: Let the real function f(x) be analytic on the interval E: $0 \leq x \leq 1$, and let $p_n(x) \not\equiv f(x)$ on E) be a polynomial of degree n which for some p, $0 < p < 1$, minimizes $\int_E |f(x) - p_n(x)|^p dx$ over all polynomials of

degree n. Let the zeros of $f(x) - p_n(x)$ on E have respective multiplicities k_j, $1 \le j \le r$, and let k_j^* be the smallest integer $\ge [(1 - p)k_j]$ and which for zeros interior to E is also of the same parity as k_j. Then one obtains the expression $\sum_{j=1}^{r} k_j^* > n$. Here, $[\sigma]$ denotes generically the largest integer not greater than σ. It follows that $k_j^* \le k_j$. The analyticity of f(x) merely to shorten the proof is required if f(z) is of class C^{n+1} provided $f - p_n$ has no zeros of multiplicity greater than n.

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

THE ROLE OF THE APPELL TRANSFORMATION IN THE THEORY OF HEAT CONDUCTION, by D. V. Widder. [1962] [14]p. (AFOSR-64-1622) (AF AFOSR-62-198) AD 446881 Unclassified

Also published in Trans. Amer. Math. Soc., v. 109: 121-134, Oct. 1963.

A function $u(x, t) \in H$ for $a < t < b$ if and only if it is a class C^2 solution of the heat equation $u_{xx} = u_t$ for $-\infty < x < \infty$, $a < t < b$. $u(x, t) \in H^*$ for $a < t < b$ if and only if for every t, t' ($a < t' < t < b$) we have $u(x, t) = \int_{-\infty}^{\infty} k(x - y, t - t')u(y, t')\,dy$, the integral converging absolutely. Here $k(x, t) = e^{-x^2/4t}(4\pi)^{-1/2}$. The Appell transformation is $A[v] = k(x, t)v(xt^{-1}, -t^{-1})$. It transforms the family of solutions of the heat equation into itself. Two typical results are the following: (i) a function u(x, t) is of the form $u(x, t) = \int_{-\infty}^{\infty} e^{ixy - ty^2}\phi(y)dy$, where ϕ is entire order 2, type $1/\sigma$, if and only if $v(x, t) \in H^*$ for $|t| < \sigma$, where $v = A[u]$; (ii) $v(x, t) \in H$ for $t < 0$ and satisfies $v \ge 0$ there if and only if $v(x, t) = \int_{-\infty}^{\infty} e^{xy + ty^2}\,d\sigma(y)$ $t < 0$, with $\sigma(y)$ increasing. (Math. Rev. abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

POSITIVE SOLUTIONS OF THE HEAT EQUATION, by D. V. Widder. [1962] [2]p. (AF AFOSR-62-198) Unclassified

Published in Bull. Amer. Math. Soc., v. 69: 111-112, Jan. 1963.

Three new integral representations associated with the heat equation (*) $u_{xx} = u_t$ are established. Necessary and sufficient conditions that u(x, t) should have the integral representation $u(x, t) = \int_{-\infty}^{\infty} \exp(xy + ty^2)\,d\sigma(y)$ for $-\infty < t < 0$ and $-\infty < x < \infty$, with $\sigma(y)$ non-decreasing, in that u(x, t) should satisfy (*) and be non-negative there. Let $k(x, t) = (4\pi t)^{-1/2} \exp(-x^2/4t)$. Necessary and sufficient conditions that u(x, t) should have the representation $u(x, t) = \int_{-\infty}^{\infty} k(y + ix, -t)\sigma(y)dy$ for $-\infty < t < 0$ and $-\infty < x < \infty$, with $\sigma(y)$ positive definite, are that u(x, t) should be non-negative and satisfy (*) there and that, in addition, $\int_{-\infty}^{\infty} u(x, t) \exp(x^2/4t_0)\,dx < \infty$ for some $t_0 < 0$. Necessary and sufficient conditions that u(x, t) have a representation $u(x, t) = \int_{-\infty}^{\infty} \exp(ixy - ty^2)\sigma(y)dy$ for $0 < t < \infty$ and $-\infty < x < \infty$, with $\sigma(y)$ positive definite, are that u(x, t) be non-negative and satisfy (*) there and that, in addition, $\int_{-\infty}^{\infty} u(x, t_0)dx < \infty$ for some $t_0 > 0$. (Math. Rev. abstract)

1107

Harvard U. Harvard Coll. Observatory, Cambridge, Mass.

RESEARCH STUDY TO CONSIDER THE ESTABLISHMENT OF AN OBSERVATORY FOR PLANETARY STUDIES NEAR CLOUDCROFT, NEW MEXICO, by B. Bell. Final rept. Apr. 30, 1962 [25]p. incl. diagrs. table. (AFOSR-2809) (AF 49(638)1155) AD 281227 Unclassified

A conference was held in Cloudcroft, New Mexico, to evaluate the suitability of a site near Cloudcroft for a planetary observatory, and to advise the Air Force on a program of planetary research. This report details the proceedings and the conclusions of the conference. The members of the committee inspected the proposed site, both from the air and in detail from the ground. This inspection yielded 2 impressions adverse to the location as a site for a major planetary observatory. In the experience of the committee, best seeing tends to be found on hills and even rather sharp peaks, not in the valley or swale type of terrain characterizing the Cloudcroft site. The committee agreed that the program described to them, including observations from rockets and balloons, fully warranted the establishment of a supporting ground facility of the type proposed by the Air Force. In view of the great expense and time required for the development of a new site, the committee suggests that consideration be given to the erection of the Air Force planetary observatory at one of the high-profile sites already developed in the southwestern United States.

1108

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

EXTERIOR ALGEBRA AND THE ACTION PRINCIPLE. I, by J. Schwinger. [1962] [9]p. (AFOSR-2639) (AF 49-(638)589) AD 612346 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 603-611, Apr. 1962.

An extension of number systems is presented by adjoining

in exterior Grassmann algebra which then can be employed in quantum field theory. A general algebraic and group theoretical basis of such a field is given. It can be used to overcome the difficulty when the quantum action principle, devised for quantum variables of type v = 2, lacks one decisive feature that would enable it to function as an instrument of calculation

1109

Harvard U [Lyman Lab. of Physics] Cambridge, Mass

INELASTIC ELECTRON SCATTERING FROM FLUCTUATIONS IN THE NUCLEAR CHARGE DISTRIBUTION, by W. Czyz and K. Gottfried. [1962] [25]p. incl. diagrs. tables, refs. (AFOSR-2757) (AF 49(638)589) AD 400862 Unclassified

Also published in Ann. Phys., v. 21: 47-71, Jan 1963.

This paper concerns itself with the cross section $\sigma(q, \omega)$ for scattering of electrons through momentum transfer q and energy loss ω from heavy nuclei. This cross section is related to the 4-dimensional Fourier transform of the nuclear time-dependent pair correlation function; this latter function gives a measure of the fluctuation of the charge density about its mean value. In an infinite medium there are regions of the q, ω plane where scattering is possible only if dynamical (in contrast to statistical) correlations are present. An argument concludes that for finite nuclei there is a well defined boundary outside of which the scattering is due solely to correlations impressed on the ground state by nuclear forces. Since one would only carry out such experiments on heavy nuclei, the break down of the Born approximation is also discussed, and it is concluded that one may readily and quite reliably correct for this. A general discussion of some possible methods for computing the relevant correlation function is given. A detailed calculation of the cross section $\sigma(q, \omega)$ for scattering from a gas of nucleons with hard core interactions is presented. This is expected to give the qualitative features of the cross section for real nuclei when the values of q and ω are properly chosen. Furthermore, it leads to estimates of the relative importance of diagrams which should be useful in more realistic nuclear models. (Contractor's abstract)

1110

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

THE DETERMINATION OF THE NUCLEAR PAIR CORRELATION FUNCTION AND MOMENTUM DISTRIBUTION, by K. Gottfried. [1962] [18]p. incl. diagrs. refs. (AFOSR-2758) (AF 49(638)589) AD 400861 Unclassified

Also published in Ann. Phys., v. 21: 29-46, Jan 1963.

This paper presents a critical discussion of some of the suggestions which have been put forward for measuring the nuclear momentum distribution F(p) and pair correlation function $C(r_1 r_2)$. On the basis of qualitative arguments, it has been concluded that a majority of the measurements of F and C are based on dubious analysis of the experimental data. In particular, the use of the impulse approximation in these analyses has been brought into question. Although the conclusion that F(p) has many high momentum components is not questioned, it is argued that there is no reliable quantitative knowledge regarding F(p) at this time. Various experiments related to the measurement of C, in particular inelastic electron scattering, and the (γpn) reaction are discussed. Here too it is concluded that the present knowledge is virtually nil. Some rigorous formulae for the cross sections measured in pursuit of F and C are also given. (Contractor's abstract)

1111

Harvard U [Lyman Lab. of Physics] Cambridge, Mass.

NON-ABELIAN GAUGE FIELDS. RELATIVISTIC INVARIANCE, by J. Schwinger. [1962] [7]p. (AFOSR-4085) (AF 49(638)589) AD 407534 Unclassified

Also published in Phys. Rev., v. 127: 324-330, July 1, 1962.

A simple criterion for Lorentz invariance in quantum field theory is stated as a commutator condition relating the energy density to the momentum density. With its aid a relativistically invariant radiation-gauge formulation is devised for a non-Abelian vector-gauge field coupled to a spin-1 2 Fermi field. (Contractor's abstract)

1112

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

VARIATIONAL FORMULATIONS OF EQUILIBRIUM STATISTICAL MECHANICS, by C. De Dominicis. [1962] [20]p. incl. diagrs. refs. (AFOSR-J219) (AF 49(638)589) AD 449988 Unclassified

Also published in Jour. Math. Phys., v. 3: 983-1002, Sept.-Oct. 1962.

Thermodynamical functions for classical and quantum systems are expressed in terms of the 1-particle density n_1 and the 2-particle correlation matrix C_{12}. Use is made of topological relations valid for the diagram representations of the grand partition function expansions. The result considered as a functional of n_1 and C_{12} is stationary under independent variations. The entropy functional of a classical system no longer contains any reference to the equilibrium parameters and the second functional derivative is a negative definite matrix. The entropy functional of a quantum system conserves traces of the equilibrium parameters in the Lee-Yang formulation; the Green's function formulation does not, but in this case the second functional derivative is no longer a negative definite matrix. (Contractor's abstract)

1113

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

GAUGE INVARIANCE AND MASS. II, by J. Schwinger. [1962] [5]p. (AFOSR-J224) (AF 49(638)589) AD 400443 Unclassified

Also published in Phys. Rev., v. 128: 2425-2429, Dec. 1962.

The possibility that a vector gauge field can imply a nonzero mass particle is illustrated by the exact solution of a 1-dimensional model. (Contractor's abstract)

1114

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

PHOTON CORRELATIONS, by R. J. Glauber. [1962] [3]p. (AFOSR-J278) (AF 49(638)589) AD 400986 Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 84-86, Feb. 1, 1963.

A general quantum mechanical method for the investigation of correlations is developed. The maser beam cannot be described by the ideally incoherent classical model used previously.

1115

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

NON-ABELIAN GAUGE FIELDS. LORENTZ GAUGE FORMULATION, by J. Schwinger. [1962] [4]p. (AFOSR-J549) (AF 49(638)589) AD 409596 Unclassified

Also published in Phys. Rev., v. 130: 402-405, Apr. 1, 1963.

Non-Abelian vector gauge theory is given a first-order Lorentz gauge formulation and then transformed into the radiation gauge. The result agrees with the independently constructed radiation gauge theory. There is a brief discussion of the axial gauge. (Contractor's abstract)

1116

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

COMMUTATION RELATIONS AND CONSERVATION LAWS, by J. Schwinger. [1962] [4]p. (AFOSR-J555) (AF 49(638)589) AD 408577 Unclassified

Also published in Phys. Rev., v. 130: 406-409, Apr. 1, 1963.

The response of a physical system to external electromagnetic and gravitational fields, as embodied in the electric current and stress tensor conservation laws, is used to derive the equal-time commutation relations for charge density and energy density. (Contractor's abstract)

1117

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

ENERGY AND MOMENTUM DENSITY IN FIELD THEORY, by J. Schwinger. [1962] [6]p. (AFOSR-J691) (AF 49(638)589) AD 413476 Unclassified

Also published in Phys. Rev., v. 130: 800-805, Apr. 15, 1963.

It is shown that the energy density commutator condition in its simplest form is valid for interacting spin 0, 1/2, 1 field systems, but not for higher spin fields. The action principle is extended, for this purpose, to arbitrary coordinate frames. There is a discussion of 4 categories of fields and some explicit consideration of spin 3/2 as the simplest example that gives additional terms in the energy density commutator. As the fundamental equation of relativistic quantum field theory, the commutator condition makes explicit the greatest physical complexity of higher spin fields (Contractor's abstract)

1118

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

QUANTIZED GRAVITATIONAL FIELD, by J. Schwinger. [1962] [6]p. (AFOSR-J705) (AF 49(638)589) AD 413639 Unclassified

Also published in Phys. Rev., v. 130: 1253-1258, May 1, 1963.

A gravitational action operator is constructed that is invariant under general coordinate transformations and local Lorentz (gauge) transformations. To interpret the formalism the arbitrariness in description must be restricted by introducing gauge conditions and coordinate conditions. The time gauge is defined by locking the time axis of the local coordinate systems to the general coordinate time axis. The resulting form of the action operator, including the contribution of a spinless matter field, enables canonical pairs of variables to be identified. There are 4 field variables that lock canonical partners, in virtue of differential constraint equations, which can be interpreted as space-time coordinate displacements. In a physically distinguished class of coordinate system the gravitational field variables are not explicit functions of the coordinate displacement parameters. There remains the freedom of Lorentz transformation. The generators of spatial translations and rotations have the correct commutation properties. The question of Lorentz invariance is left undecided since the energy density operator is only given implicitly

1119

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

DENSITY-CORRELATION FUNCTION IN A DILUTE CONDENSED BOSE GAS (Abstract), by P. C. Hohenberg. [1962] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 267, Apr. 23, 1962.

Using mass-operator perturbation theory modified to take into account the macroscopic occupation of the k=0 mode, calculations have been made on the true density excitations of a dilute Bose gas with weak short-range repulsive interactions at low temperatures, in the approximation beyond Bogoliubov in the parameter $(n_0 a^3)^{\frac{1}{2}}$. These excitations identified in the poles of the density-correlation function $L(k, \omega)$, are the ones which are measured in slow neutron-scattering experiments, as opposed to the phonons calculated by previous authors, associated with the single-particle Green's function. $L(k, \omega)$ is obtained by solving a set of coupled matrix equations which insure that the conservation laws and sum rule are satisfied in analogy with the calculation of collective excitations in superconductors. For low wavenumbers, the resulting spectrum of $L(k, \omega)$ reduces to the phonon spectrum calculated at zero temperature by Beliaev. Thus, at zero temperature, it yields density waves with the compressional velocity as calculated from thermodynamics.

1120

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass

AN ELECTRON IMPACT STUDY OF 1,1,1-TRIFLUOROETHANE, 1,1,1-TRIFLUOROPENTANE AND 3,3,3-TRIFLUOROPROPENE, by W. C. Steele and F. G. A. Stone. [1962] [5]p. incl. tables, refs. (AFOSR-2192) (AF 49(638)518) Unclassified

Also published in Jour. Amer. Chem Soc., v. 84: 3450-3454, Sept. 20, 1962.

For abstract see item no. 1121, Vol. VI.

1121

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

AN ELECTRON IMPACT STUDY OF 1,1,1-TRIFLUOROETHANE, 1,1,1-TRIFLUOROPENTANE AND 3,3,3-TRIFLUOROPROPENE, by W. C. Steele and F. G. A. Stone. [1962] [5]p. incl. tables, refs. (AFOSR-J239) (AF 49(638)518) Unclassified

Also published in Jour. Amer. Chem Soc., v. 84: 3450-3454, Sept. 20, 1962.

The appearance potentials of the major positive ions in the mass spectra of 1,1,1-trifluoroethane, 1,1,1-trifluoropropane and 3,3,3-trifluoropropene have been measured. The R-CF_3 bond dissociation energy and the heat of formation are reported for each compound. The various processes for dissociation under electron impact are discussed. (Contractor's abstract)

1122

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

SILICON-SILICON BOND DISSOCIATION ENERGIES IN DISILANE AND HEXACHLORODISILANE, by W. C. Steele and F. G. A. Stone. [1962] [2]p. incl. table. (AFOSR-J240) (AF 49(638)518) Unclassified

Also published in Jour. Amer Chem Soc., v. 84: 3599-3600, Sept. 20, 1962.

Bonds formed by silicon to other elements are generally stronger than those formed by carbon. Moreover, chemical evidence exists suggesting that Si-Si bonds are in some cases more stable thermally than corresponding C-C bonds. Limited thermochemical data for the Si-Si bond, on the other hand, have given the impression that this bond is considerably weaker than a C-C bond. Thus, a thermochemical bond energy E(Si-Si) = 46.4 kcal. mol^{-1} has been calculated for disilane, and the activation energy for pyrolysis of disilane has been taken to imply a value for $D(H_3Si\text{-}SiH_3)$ of ~50 kcal mol^{-1}. For ethane, $D(H_3C\text{-}CH_3)$ = 83 kcal mol^{-1}. The dissociation energies of the Si-Si bonds in disilane and hexachlorodisilane have been measured by electron impact, and have found that they are comparable in strength to C-C bonds. The higher values for D(Si-Si) reported here permit a better understanding of recent observations of the properties of several substances with Si-Si bonds than the earlier results.

1123

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

THE DETERMINATION OF SILICON-CARBON AND SILICON-HYDROGEN BOND DISSOCIATION ENERGIES BY ELECTRON IMPACT, by W. C. Steele, L. D. Nichols, and F. G. A. Stone. [1962] [5]p. incl. tables, refs. (AFOSR-J356) (AF 49(638)518) AD 408031 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 4441-4445, Dec. 5, 1962.

Appearance potentials of selected ions in the mass spectra of silane, tri- and tetrachlorosilane and the methyl-, ethyl-, isopropyl- and tert-butylsilanes and trichlorosilanes have been measured. The Si-C bond dissociation energies in the organosilanes have been calculated, the results being in general higher than the C-C bond

dissociation energies in the corresponding alkanes. A definite dependence on the nature of the alkyl group is observed. The S-H bond dissociation energies in silane and trichlorosilane are found to be 94 ± 2 and 93 ± 4 kcal mol^{-1}, respectively. The Si-Cl bond dissociation energy in tetrachlorosilane is calculated to be 106 ± 4 kcal mol^{-1}. (Contractor's abstract)

1124

Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.

SHAPE AND ARRANGEMENT OF COLUMNS IN CAT'S STRIATE CORTEX, by D. H. Hubel and T. N. Wiesel. [1962] [12]p. incl. illus. diagrs. (AFOSR-J534) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-76 and Public Health Service)
Unclassified

Also published in Jour. Physiol (London), v. 165: 559-568, Mar. 1963.

Previous studies have shown that the striate cortex of the cat is subdivided into columnar regions of cells having a common receptive-field axis orientation. The present paper describes further observations on the shape and arrangement of the columns. From multiple parallel penetrations the walls of columns appear to be parallel to the radial fiber bundles of the cortex and perpendicular to the cortical layers. The surface mosaic formed by the intersection of the columnar walls with the cortical surface is highly irregular. Some columns appear to be compact in shape (more or less round or oval), while others seem to be very long and narrow. In some parts of the cortex columns are arranged in a very regular manner. Here the discrete shifts in orientation as one moves along the cortical surface in a straight line are small, and the direction of the shifts may be the same, clockwise or counterclockwise, over long sequences. In these ordered regions the columns are especially likely to be long and narrow. In other parts of the cortex there appears to be little if any order to the arrangement of neighboring columns.

1125

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

COMMON SECANTS FOR FAMILIES OF POLYHEDRA, by B. Grünbaum. Dec. 1961, 10p. incl. diagrs (Technical scientific note no. 23) (AFOSR-2698) (AF 61(052)187) AD 280291 Unclassified

Also published in Arch. Math., v. 15: 78-80, 1962

Definitions. (1) A convex cone C with vertex at the origin is called the associated cone of a convex polyhedron $P \subset E^n$ with respect to the vertex v of P if $v + C$ is the union of all half-lines with endpoint v which contain at least one point of P different from v. A polyhedron P' is related to a polyhedron P provided each associated cone of P' is an intersection of associated cones of P. A family $\mathcal{P}$ of polyhedra is related to P if each member of $\mathcal{P}$ is related to P. (2) A family $\mathcal{P}$ of polyhedra in E^n is said to have property S if there exists a hyperplane intersecting every member of P; the family $\mathcal{P}$ is said to have property S(k) if every k-membered subfamily of $\mathcal{P}$ has property S. With these definitions the author proves the following theorems: (1) For families $\mathcal{P}$ related to a centrally symmetric convex polyhedron $P \subset E^n$ with 2p vertices, S(p(n + 1)) implies S. (2) For every positive integer k there exists a $t = t(k, n)$ such that for families $\mathcal{P}$ related to a convex polyhedron $P \subset E^n$ with k vertices, S(t) implies S; moreover, one may take $t(k, n) \leq \binom{k}{2}(n + 1)$. (3) Let a centrally symmetric convex body $K \subset E^2$ have the property that S(t) implies S for families of positive homothets of K, where t depends on K only; then K is a polygon. (Math. Rev. abstract)

1126

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

ON A PAPER OF A. FELDZAMEN, by S. R. Foguel. Jan. 1962, 9p. (Technical scientific note no. 24) (AFOSR-2699) (AF 61(052)187) AD 280982
Unclassified

Also published in Israel Jour. Math., v. 1: 133-138, Sept. 1963.

The author gives proofs of A. N. Feldzamen's theorems on semi-similarity of spectral operators of finite multiplicity on Hilbert space (Trans. Amer. Math. Soc., v. 100: 277-324, 1951). The proofs use the author's representation of such an operator through matrices whose elements are bounded Borel functions on the spectrum of the operator; this effects a considerable conceptual simplification. (Math. Rev. abstract)

1127

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

CHARACTERISATION OF C(Ω), by Y. Katznelson. Feb. 1962, 5p. (Technical scientific note no. 25) (AFOSR-2700) (AF 61(052)187) AD 280980
Unclassified

Consider a Banach algebra B of continuous functions on a compact Hausdorff space Ω. The purpose of this note is to prove the following theorem which generalizes the main result of a prior publication (Bull. Amer. Math. Soc., v. 66: 313-315, 1960). Theorem: Assume that for every closed subset F of Ω, there exists a positive number $\xi = \xi(F)$ such that whenever N is both closed and open in F, B contains an element h of norm one satisfying $\mathrm{Re}(h(M)) < 0$ for $M \in N$, $\mathrm{Re}(h(M)) > \xi$ for $M \in F - N$. Then $B = C(\Omega)$. The main difference between the present result and that of the previous publication is that here, the assumption that B is self adjoint and regular is discarded, and instead of assuming the boundedness of idempotents, a uniform separation of parts of F by elements of B of norm one for every closed $F \subset \Omega$ is assumed.

1128

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

TAUBERIAN CONSTANTS FOR THE ABEL AND CESARO TRANSFORMATIONS, by A. Jakimovski. 1962] 15p. (Technical note no 26) (AFOSR-2914) (AF 61(052)187) AD 277488 Unclassified

Also published in Proc. Amer Math. Soc., v. 14: 228-238, Apr. 1963.

Let S_n, $S_n = a_0 + a_1 + \cdots + a_n$, be a real or complex sequence. Let $t(x) = \sum_0^\infty a_m x^m$, the Abel transform of S_n. Speaking very generally, this paper concerns itself with the estimation of $\limsup |S_n - t(x)|$ as $n \to \infty$, $x \to 1$, $n(1-x) \to q > 0$. If the sequence S_n is replaced by a Cesaro transform of order $\alpha > -1$, $C_n^{(\alpha)}$, where

$$C_n^{(\alpha)} = \binom{n+\alpha}{n}^{-1} \sum_{m=0}^{n} \binom{n-m+\alpha-1}{n-m} S_m,$$

similar questions are raised. Let $a_n^{(\alpha)}$ denote the Cesaro transform of order $\alpha > -1$ of the sequence na_n. Two of the principal results are: (I) Suppose β and q are such that $q > 0$, $0 \le \beta \le 1$. Then for S_n satisfying $|a_n^{(\beta)}| \le K < +\infty$, we have $\limsup_{n\to\infty, x\to 1, n(1-x)\to q} |S_n - t(x)| \le A_q^{(\beta)} \limsup_{n\to\infty} |a_n^{(\beta)}|$, where

$$A_q^{(\beta)} = \gamma + \log q + \frac{2}{\Gamma(\beta+1)} \int_q^\infty v^\beta e^{-v} \log(v/q)\, dv.$$

The constant $A_q^{(\beta)}$ is best in the sense that there is a real sequence $\{S_n\}$ such that $0 < \limsup_{n\to\infty} |a_n^{(\beta)}| < +\infty$ and we have equality in (*). (II) Suppose α, β, q are such that $q > 0$ and $-1 < \alpha \le \beta \le \alpha + 1$. Then for S_n as in (I) we have (**) $\limsup_{n\to\infty, x\to 1, n(1-x)\to q}$ where

$$|C_n^{(\alpha)} - t(x)| \le C_q^{(\alpha,\beta)} \limsup |a_n^{(\beta)}|, \quad C_q^{(\alpha,\beta)} = \gamma + \log q - \int_0^1 \frac{1-(1-u)^\alpha}{u}\, du$$

$$+ \frac{2}{\Gamma(\alpha+1)} \int_q^\infty v^\beta e^{-v} \log(v/q)\, dv.$$

The constant $C_q^{(\alpha,\beta)}$ is best possible in the sense that there is a S_n as in (I) for which (**) is an equality. Another theorem is given which similarly estimates $\limsup_{n\to\infty} |C_n^{(\alpha)} - C_n^{(\beta)}|$.

These results are applied to investigate some relations between the limit points of sequences and those of their Abel transforms. The estimates given are considerable generalizations of previous results of R. P. Agnew (Math. Rev. abstract)

1129

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel)

ON THE UNITARY PART OF A CONTRACTION, by S. R. Foguel. May 1962, 9p. (Technical note no. 27) (AFOSR-2915) (AF 61(052)187) AD 277489 Unclassified

For every contraction on a Hilbert space, a subspace is defined on which the operator was unitary. This analysis considers this subspace and compare it with the spectral decomposition of the operator. (Contractor's abstract)

1130

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

EXTENSION OF COMPACT OPERATORS I, by J. Lindenstrauss. May 1962, 45p. incl. refs. (Technical note no 28) (AFOSR-3131) (AF 61(052)187) AD 281929 Unclassified

The relationships between various extension properties for compact operations are studied and the spaces having these properties are investigated. (Contractor's abstract)

1131

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

EXTENSION OF COMPACT OPERATORS II, by J. Lindenstrauss. June 1962, 40p. incl refs. (Technical note no. 31) (AFOSR-3132) (AF 61(052)187) AD 281929 Unclassified

Certain intersection properties of cells in normed spaces are studied. In particular, some results relating these properties with extension properties for compact operators are proved. (Contractor's abstract, modified)

1132

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

EXTENSION OF COMPACT OPERATORS III, by J. Lindenstrauss. July 1962, 53p. incl. refs. (Technical note no 32) (AFOSR-3133) (AF 61(052)187) AD 281930 Unclassified

The class of the spaces X for which X^{**} is a $_1$ space is characterized. Some subclasses (C(K) spaces, polyhedral spaces) are investigated in detail. The main interest is in the extension properties of these spaces. (Contractor's abstract)

1133

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

CONVEXITY THEOREMS AND LOWER BOUNDS FOR SOLUTIONS OF DIFFERENTIAL EQUATIONS IN

BANACH SPACES, by S. Agmon and L. Nirenberg. June 1962, 26p. incl. refs. (Technical note no. 33) (AFOSR-3134) (AF 61(052)187) AD 281931 Unclassified

The purpose of this analysis is to show that similar results hold in a much more general case, when A is a normal multiple of an infinitesimal generator of a one parameter group of bounded operators in Banach spaces. The advantage of the result in this more general situation is that it applies to general Banach spaces and admits a much wider range of applications to differential problems. (Contractor's abstract)

1134

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

MIXED PROBLEMS FOR HIGHER ORDER HYPERBOLIC EQUATIONS, by S. Agmon. May 1962, 9p. incl. refs. (Technical note no. 29) (AFOSR-3187) (AF 61(052)187) AD 282425 Unclassified

Also published in Les Equations aux Dérivées Partielles Paris (France), 1962. Paris, Editions du Centre National de la Recherche Scientifique, 1963, p. 13-18.

Mixed problems for higher-order hyperbolic equations in any number of variables are discussed under the following restrictive assumptions: (1) the differential operators possess constant coefficients (more generally, the operators possess constant principal parts), and (2) the underlying domain is a quarter space or a semi-infinite strip. (Contractor's abstract)

1135

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

CONTRACTIONS AND THEIR QUADRATIC FORMS, by S. R. Foguel. June 1962, 11p. (Technical note no. 34) (AFOSR-3188) (AF 61(052)187) AD 282441 Unclassified

The results shown in previous papers (item nos. 982 and 985, Vol. V) are generalized by not assuming a Doeblin condition, and the limits of $\Sigma P^n x, y$ are studied.

1136

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

COMPLEX FUNCTION THEORY OVER NON-ARCHIMEDEAN FIELDS, by A. Robinson. June 1962, 127p. incl. refs. (Technical note no. 30) (AFOSR-3189) (AF 61(052)187) AD 282416 Unclassified

A satisfactory theory of complex functions is shown to exist over certain non-Archimedean fields. The theory is applied to the simplification and development of some branches of classical function theory. New results are obtained concerning the zeros of complex polynomials and on the behavior of an analytic function in the neighborhood of an essential singularity. Mathematical logic provides a basic part of the arguments used in this paper. (Contractor's abstract)

1137

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

RESEARCH IN THE AREA OF MATHEMATICAL ANALYSIS, by S. Agmon A Dvoretzky and others. Final rept. Nov. 1, 1958 - Sept. 30, 1962. Oct. 1962, 64p. incl. refs. (AFOSR-4367) (AF 61(052)187) AD 295048 Unclassified

This research in the area of mathematical analysis covers various topics, such as: (1) Analytic functions of the classes L^2 and l^2 and their kernel functions, (2) The product of summability methods; (3) Local partial differential algebra; (4) Contractions and their quadratic forms; (5) Hadamard type compositions in analytic functions; (6) Concept of a differentially closed field, and (7) The L_p approach to the Dirichlet problem.

1138

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

A MEASURE OF ASYMMETRY FOR PLANE CONVEX SETS, by B. Grünbaum. Nov. 1962, 12p. incl. diagrs. (Technical note no. 35) (AFOSR-4585) (AF 61(052)187) AD 401032 Unclassified

Also published in Jour. London Math. Soc., v. 39: 95-102, 1964.

A functional related to the notion of sixpartite points is defined for convex bodies in the plane. Its extreme values are determined and it is proved that the functional is a measure of asymmetry. (Contractor's abstract)

1139

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

POSITIVITY INTERVALS OF STABLE PROCESSES, by H. Kesten. [1962] [26]p. incl. refs. [AF 61(052)187] Unclassified

Published in Jour. Math. and Mech., v. 12: 391-410, May 1963.

Suppose $\{x_t(\omega)\}$ is a separable symmetric stable process of index $\sigma \in (0,2]$; take $x_0 = 0$. Let $A(\omega) = \{t: 0 \le t \le 1$ and $x_t(\omega) > 0\}$. With probability 1, the positivity set $A(\omega)$ has a unique representation as a union of maximal disjoint intervals. Write $N(\epsilon, \omega)$ for the number of these intervals of length at least ϵ. The three main results of this paper give the limiting distributions for $N(\epsilon, \omega) f_\alpha^{-1}(\epsilon)$ as $\epsilon \to 0$ in the cases $1 < \alpha \le 2$, $\alpha = 1$ and $0 < \alpha < 1$. Here $f_\alpha(\epsilon)$ is a normalizing factor which is proportional to $\epsilon^{(1/\sigma)-1}$ when $\sigma > 1$, to $(\log \epsilon)^2$ when $\sigma = 1$ and to

log x for $\alpha < 1$. The distributions are of the Mittag-Leffler type in the first case, and degenerate at a positive constant in the third. It is pointed out that in all 3 cases the form of the normalizing function and of the limiting distribution agrees with asymptotic results on the number of changes of sign by partial sums of independent, stable random variables.

1140

Hebrew U. Dept. of Physics, Jerusalem (Israel).

[NEW PARAMAGNETIC RESONANCE SPECTRA OF RARE EARTH IONS IN CALCIUM FLUORIDE] Nouveau spectre de résonance paramagnétique d'ions de terres rares dans le fluorure de calcium, by W. Low and U. Rosenberger. [1962] [3]p. incl. refs. (AFOSR-4306) (AF 61(052)59) AD 405009 Unclassified

Also published in Compt. Rend. Seances Acad. Sci., v. 254: 1771-1773, Mar. 1962.

The paramagnetic resonance of Yb^{3+} in calcium fluoride is described. The spectrum has a triangular symmetry and may be represented by a Hamiltonian spin $H = g_{\parallel} \beta H S_z + g_{\perp} \beta(H_x S_x - H_y S_y) + A S_z I_z + B(S_x I_x + S_y I_y) + Q'(I_z^2 - 1/3\, I(I+1))$ - with $g_{\parallel} = 1.323 \pm 0.001$, $g_{\perp} = 4.389 \pm 0.004$, $A_{171} = 359 \pm 3$, $A_{173} = 96 \pm 1$, $B_{171} = 1174 \pm 5$, $B_{173} = 320 \pm 3$, $Q' = 85 \pm 4$, all in $10^{-4}cm^{-1}$. The estimated magnetic moments are $\mu^{171} = 8.43$, $\mu^{173} = 0.59$ and Q is nearly 2.4 barns. (Contractor's abstract)

1141

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ELECTRON SPIN RESONANCE IN THE CUBIC CRYSTALLINE FIELD OF CALCIUM OXIDE by W. Low and R. S. Rubins. June 1962, 3p. incl. tables, refs. (Technical note no. 20) (AFOSR-4589) (AF 61(052)59) AD 434395 Unclassified

Also published in Phys. Ltrs., v. 1: 316-317, July 1962.

Electron spin resonance measurements are reported for V^{2+}, Cr^{3+}, Mn^{2+}, Fe^{3+}, Co^{2+} and Ni^{2+} in single crystal CaO and compared with the results for these ions in Mg and CaF_2. Although some of the results can be interpreted by postulating a crystalline field smaller than MgO, there remains a number of unexplained anomalies.

1142

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRUM OF GADOLINIUM IN $LaAlO_3$, by W. Low and A. Zusman. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0471) [AF 61(052)59] AD 435656 Unclassified

Also published in Phys. Rev., v. 130: 144-150, Apr. 1, 1963.

The resonance spectrum of Gd^{3+} in $LaAlO_3$ was investigated as a function of the temperature. It was found that the trigonal parameter b_2^0 changes smoothly from $67 \times 10^{-4}cm^{-1}$ at 689°K to $421 \times 10^{-4}cm^{-1}$ at 20°K. The transition to cubic phase is found by extrapolation to be at 720 ± 15°K. The spin Hamiltonian appropriate to the trigonal phase is given by $H = g\beta H \cdot S + B_2^0 O_2^0 + B_4^0 O_4^0 + B_6^0 O_6^0 + B_4^3 O_4^3 + B_6^3 O_6^3 + B_6^6 O_6^6$. The evaluation of the magnitude of the various parameters B_m^n is presented.

1143

Hebrew U. Dept. of Physics, Jerusalem (Israel).

EFFECT OF RADIATION AND HEAT TREATMENT ON THE PARAMAGNETIC RESONANCE SPECTRUM OF Yb^{3+} IN CaF_2, by W. Low and U. Ranon. [1962] 7p. (AF 61(052)59) Unclassified

A single crystal of CaF_2 of reddish color, containing 0.05 - 0.5% ytterbium was investigated at 20°K and 3 cm wavelength. Four sets of 2 lines were seen, each doublet having trigonal symmetry along one of the body diagonals. Each of the 8 strong lines was accompanied by a hyperfine structure from the 2 odd isotopes 171 and 173 with spin 1/2 and 5/2, respectively. After heating in hydrogen for several hours, an additional spectrum with trigonal symmetry appeared. Irradiation with light diminishes its intensity and strengthens the intensity of the original trigonal spectrum. The crystal with the trigonal spectrum was irradiated with γ rays. The original spectrum disappeared nearly completely and the color of the crystal changed to a deep green. A new isotopic paramagnetic resonance spectrum of considerable intensity appeared which has the same parameters in the spin Hamiltonian as those reported by Low. The isotopic spectrum disappeared completely when the irradiated crystal was heated in vacuum to about 500°C. The low intensity trigonal spectrum remained; the crystal itself became transparent. On irradiation with γ rays, the isotropic spectrum reappeared. The irradiated spectrum showed a sharp absorption line at about 10365 cm^{-1}, characteristic of the cubic field spectrum. In addition, there are a number of very strong absorption bands in the visible and ultraviolet spectrum.

1144

Hebrew U. Dept. of Physics, Jerusalem (Israel).

INFLUENCE OF A RESONANT ABSORBER WHOSE THICKNESS VARIES LINEARLY WITH TIME ON THE

SPECTRAL SHAPE OF AN INCIDENT LORENTZIAN WAVE PACKET, by I. Nowik. Jan. 1962 [9]p. incl. diagrs. (Technical note no. 5) (AF 61(052)347) AD 280024 Unclassified

Also published in Phys. Rev., v. 126: 1878-1879, June 1, 1962.

The influence of a resonant absorber whose thickness varies linearly with time on the spectral shape of an incident Lorentzian wave packet is discussed, using classical dispersion theory. The resonant line is broadened and, for high enough velocities with which the thickness of the absorber changes, the line is split into 2 bands with a minimum at the resonant frequency ω_0. (Contractor's abstract)

1145

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE INTERACTIONS IN THE 2+ ROTATIONAL STATE OF Dy^{160} IN DYSPROSIUM IRON GARNET, by R. Bauminger, S. G. Cohen and others. Feb. 1962 [27]p. incl. diagrs. refs. (Technical note no. 6) (AFOSR-2535) (AF 61(052)347) AD 274553 Unclassified

The hyperfine interactions of the 2+ rotational level of Dy^{160} at 87 kev in dysprosium iron garnet have been measured at 94°K using the technique of Mössbauer absorption. The results are $g\mu_n H_{eff}$ = (930 ± 50) mcs/sec and eqQ/4 = (-77 ± 15) mcs/sec. A comparison with previous similar measurements in Dy^{161} together with the knowledge of the g factor of the Dy^{161} ground state from spin resonance experiments gives a value of 0.48 ± 0.07 for the g factor of the 2+ rotational level of Dy^{160}, assuming Judd and Lindgren's values for $< 1/r^3 >$. The sign of the spectroscopic quadrupole moment of this state is found to be negative, as to be expected as a consequence of the nuclear collective rotation. The ratio of quadrupole moments $Q_{160}(2+)$. Q_{161} (ground state) was found to be -0.77 ± 0.25. Comparing a model dependent estimate of $Q_{160}(2+)$ with a value of Q obtained from the experimental results a value of about 0.2 is obtained for the Sternheimer shielding factor. (Contractor's abstract)

1146

Hebrew U. [Dept. of Physics] Jerusalem (Israel).

A STUDY OF THE INTERNAL FIELDS ACTING ON NUCLEI IN SOLIDS USING THE TECHNIQUES OF THE MÖSSBAUER ABSORPTION AND PERTURBATION OF γ-γ CASCADES, by S. G. Cohen. Annual summary rept. Jan. 1, 1960 - Dec. 31, 1961. Jan. 22, 1962, 8p. (AFOSR-2929) (AF 61(052)347) AD 277610 Unclassified

Internal fields acting on nuclei in solids are determined using the techniques of recoil-free resonance absorption and the perturbation of the angular correlation of gamma-ray cascades. Such measurements provide information concerning the following: (1) The internal magnetic fields acting on rare earth nuclei in garnets and other ferrimagnetic materials, (2) The effective electric field gradients acting on rare earth nuclei and their temperature dependence and correlation with bulk magnetic properties; (3) The chemical and isomeric shift in Mössbauer absorption spectra of rare earth nuclei in different solids, leading to knowledge of the atomic s-like wave functions; and (4) the internal magnetic fields acting on iron nuclei in magnetite through the transition temperature region.

1147

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE INTERACTIONS OF THE 2+ STATE IN Dy^{160} SITUATED IN DYSPROSIUM IRON GARNET USING γ-γ ANGULAR CORRELATION TECHNIQUE, by S. G. Cohen and G. Gilat. June 1962 [22]p. incl. diagrs. table, refs. (Technical note no. 7) (AFOSR-3441) (AF 61(052)347) AD 284411 Unclassified

Also published in Nuclear Phys., v. 38: 1-10, Oct. 1962. (AFOSR-4446; AD 295852) (Title varies)

The hyperfine interaction of the 2+ state in Dy^{160} situated in ferrimagnetic dysprosium iron garnet (DIG) has been studied at room temperature by measuring the perturbation of the angular correlation of γ-cascades passing through this state. A large rotation of the angular correlation pattern was observed when the domains are aligned in an external magnetic field perpendicular to the plane of the counters. A longitudinal external field was used to decouple the effectively static part of the hyperfine interaction and isolate the time dependent interactions. $g\mu_n H_{eff}$ h is found to be (160 ± 50) mc/s. Assuming H_{eff} equals to 6 0 x 10^5 Oe from recoil-free experiments one obtains for the g factor of the 2+ state 0.32 ± 0.10. The relaxation times characterizing the time dependent perturbations are estimated to be 1.5 ± 0.5) x 10^{-12} sec for DIG and (0.9 ± 0.3) x 10^{-12} sec for aqueous solution of $TbCl_3$. (Contractor's abstract)

1148

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE INTERACTIONS OF THE 2+ STATE IN Dy^{160}, by S. G. Cohen and G. Gilat. [1962] [10]p. incl. diagrs. refs. (AFOSR-4446) (AF 61(052)347) AD 295852 Unclassified

Also published in Nuclear Phys., v. 38: 1-10, Oct. 1962.

For abstract see item no. 1147, Vol. VI.

1149

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE INTERACTIONS IN THE GROUND STATE AND FIRST EXCITED STATE OF Tm^{169} IN THULIUM IRON GARNET, by I. Nowik and S. Ofer. [1962] [3]p incl. diagrs. table, refs. (AFOSR-J265) (AF 61(052)-347) AD 400887 Unclassified

Also published in Phys. Ltrs., v. 3: 192-194, Nov. 1962.

The Mössbauer spectrum of the 8.6 kev γ-ray from the first excited state of Tm^{169} ($\tau_{1/2} = 6.6 \times 10^{-9}$ sec) in thulium iron garnet was observed at 90°K and 300°K. The results at 90°K were fitted to parameters in the equation for the splitting of each level energy, $W = \Delta E + mg\beta_n H_{eff} + 1/4\ eqQ[3m^2-I(I+1)]/[I(2I-1)]$, including a possible axially symmetric quadrupole term for the 8.6 kev level, as well as hyperfine interaction with an internal field H_{eff} (effective magnetic field) due to spontaneous magnetization of the rare earth sublattice, and a chemical shift. The result for H_{eff} at 90°K is $(3.8 \pm 0.8) \times 10^5$Oe compared with $(3.5 \pm 0.5) \times 10^6$Oe for H_{eff} in dysprosium iron garnet. This difference may be accounted for by the theory of quenching of orbital angular momentum of the Tm ion. A value of $+0.73 \pm 0.16$ is obtained for the magnetic moment of the 8.6 kev 3^2 level. The 300°K results indicate a ration $H_{eff}(300°K)\ H_{eff}(90°K) = 0.42 \pm 0.10$.

1150

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ELECTRON DENSITY IONIZATION RATE AND APPROACH TO THERMAL EQUILIBRIUM BEHIND SHOCK WAVES BY MEANS OF MICROWAVE TECHNIQUE, by W. Low. Annual summary rept. no. 1, Sept. 1, 1961 - Aug. 31, 1962 [8]p. incl. illus. (AFOSR-4061) (AF 61-(052)401) AD 290667 Unclassified

The shape of the attenuation line of a series of shocks $p_1 = 5$ mm Hg with various mach numbers and the shape of the attenuation line of shocks passing from a large diameter shock tube to small diameter shock tube was studied. Experiments with a magnetic probe set-up (Lin et al.) for D.C. conductivity measurements were investigated for their adaptability for measuring the ionization profiles in the z direction (tube axis direction).

1151

Hebrew U. Dept. of Physics, Jerusalem (Israel).

THE DESIGN AND USE OF A MILLIMETER WAVE FABRY PEROT INTERFEROMETER FOR SHOCK WAVE DIAGNOSTICS, by E. Ravid, J. Alon, and W. Low. [1962] [4]p. (Bound with its AFOSR-4061; AD 290667) (AF 61(052)401) Unclassified

The interaction of a shock wave and e.m. wave can be defined in terms of the complex, time varying permittivity of the shock wave region $\mathcal{E}^* = \mathcal{E}' - j\mathcal{E}''$. From this point of view, the use of a Fabry Perot interferometer offers the advantage of having a highly pure plane wave act as the probing field. In analogy with its optical counterpart, a millimeter wave Fabry Perot interferometer consists of 2 parallel plates, either of lossless dielectric or of perforated sheet metal. These plates can be moved with respect to each other and at certain discrete distances the plates offer a matched system, i.e., they are equivalent to a tuned cavity and a peak in the output is obtained. Any change in the characteristics of the medium between the plates destroys the resonance condition and causes a shift in the amplitude and phase of the emerging wave.

1152

Hebrew U. [Dept. of Physics] Jerusalem (Israel).

POSSIBLE SOLID-STATE EFFECT ON THE DEGREE OF IONIZATION OBTAINED IN A VACUUM SPARK, by B. S. Fraenkel. [1962] [1]p. incl. table. (AFOSR-3656) (AF EOAR-62-33) Unclassified

Also published in Jour. Appl. Phys., v. 33: 2141, June 1962.

A predicted triplet state, $3d^5\ ^6S\text{-}4p\ ^6P$ of Zn VIII at 160 A appears when a brass electrode is used, but not with a pure zinc electrode. This suggests an influence of the crystal structure (pure Zn against Zn in brass crystal) on the degree of ionization in the vacuum spark. Although the difference of the binding energy of Zn atoms in the 2 crystals is only of the order of one electron volt, the difference in ionization energy obtained is of the order of hundreds of electron volts. No theory is proposed as yet to explain this effect.

1153

Hebrew U. Dept. of Physics, Jerusalem (Israel).

VACUUM ULTRAVIOLET SPECTROMETER, by E. Alexander and B. S. Fraenkel. Feb. 1962 [14]p. incl. illus. diagrs. (Technical rept. no. 1) (AFOSR-4690) (AF EOAR-62-33) AD 410159 Unclassified

Also published in Rev. Scient. Instr., v. 34: 887-890 Aug. 1963.

A grazing incidence vacuum spectrometer is described. It is based on a 2 m, 30,000 lines in. Siegbahn glass grating. Both plate-holder and grating are held on arms fastened to the axis of the Rowland circle. The wavelength range extends up to 2300 A. Instrumental considerations for obtaining high resolution in the short wavelength range are discussed. (Contractor's abstract)

1154

Hebrew U. Dept. of Physics, Jerusalem (Israel).

REVIEW OF THE RESEARCH IN PROGRESS IN THE VACUUM ULTRAVIOLET, by E. Alexander, B. S. Fraenkel and others. [1962] [4]p. incl. table. (AFOSR-J152) (AF EOAR-62-33) AD 400065 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 725-728, Oct./Dec. 1962.

Details of the 2 meter grazing incidence spectrometers are given and attempts are described to obtain the soft x-ray M-bands of gallium. Multiply-ionized atomic spectra are being studied using the sliding spark technique and the triggered vacuum spark. Preliminary wavelengths and intensity ratios for the Zn VIII triplet at 160 A are presented.

1155

Hebrew U. Dept. of Sociology, Jerusalem (Israel).

SOME PROBLEMS OF ROLE ANALYSIS, by S. N. Eisenstadt, R. Bar-Yosef and others. Jan. 1962, 24p. incl. refs. (Technical note no. 4) (AFOSR-2242) (AF 61(052)480) AD 279616 Unclassified

The sociological concept 'role', is examined critically. Several conclusions are drawn about possible revisions of some of the basic assumptions underlying the use of this concept, and some possibilities of further research in this area are indicated. (Contractor's abstract)

1156

Hebrew U. Dept. of Sociology, Jerusalem (Israel).

THE IMPACT OF PERSONAL ATTRIBUTES. HUMAN QUALITIES AND PRIMORDIAL TIES ON ROLE BEHAVIOUR, by H. R. Shlonsky. Sept. 1962, 12p. (Technical note no. 5) (AFOSR-4957) (AF 61(052)480) AD 290680 Unclassified

This study is intended as a preliminary attempt to explore precisely those attributes of the individual which are in a way prior to the formal definitions of roles and are at the same time not only starting points for individuals' motivation for role taking and role performance, but may also influence the very processes of crystallization of social behavior into roles and the differentiation of roles on the basis of their respective content. This study was begun by delineating the area for exploration. A number of phenomena which did not fit into accepted sociological categories and constituted a residual category, including different aspects of social behavior with a vague common denominator were pointed out. Three kinds of attributes for preliminary investigation were then specified: biological attributes, group membership qualities, and personal traits. These may be looked upon as certain aspects of an individual's human image. Their common denominator is that they reflect some qualities of man as givens or primordials, that is to say, as evaluations of man's possible resources, or his potential. The human image is not conceived here as an isolated psychological variable but, rather, as a pattern (or system), of attributes toward basic aspects of man and human activity which is significant in regulating the meeting point between personality and social roles and groups. (Contractor's abstract)

1157

Hebrew U. Dept. of Sociology, Jerusalem (Israel).

IMAGES PERTAINING TO CHOICE OF OCCUPATION, THEIR SOURCES AND THEIR INFLUENCE ON THIS CHOICE, by H. Weihl and E. Yuchtmann. Oct. 1962, 42p. incl. tables, refs. (Technical note no. 6) (AFOSR-4164) (AF 61(052)480) AD 292251 Unclassified

Having regard to a model of role as its general framework, the potential influence of certain pre-situational factors on role functioning is discussed. This report deals mainly with motivation as one of such factors, aiming to locate some of the factors contributing to its formation. A examination of the relationship between pre-situational factors and actual role-performance would have necessitated a follow-up study of the respondents on their taking up their various occupational roles. Though such a study was not available, the existing empirical material enabled us to show that without considering pre-situational factors such as motivation, no clear understanding of proper role functioning, as well as of motives governing choice of an occupational role (or any role), could be achieved. (Contractor's abstract)

1158

Heidelberg U. Pharmacology Inst. (Germany).

[EVALUATION OF ANTIRHEUMATIC DRUGS ON THE BASIS OF THEIR PROBABLE MECHANISM OF ACTION] Testierung antirheumatischer Stoffe auf der Basis ihres vermutlichen Wirkungsmechanismus, by F. Eichholtz and K. Alexander. [1961] [21]p. incl. illus. diagrs. tables, refs. (AFOSR-2619) [AF 61(514)1006] AD 632144 Unclassified

Also published in Arzneimittel Forsch. (Drug Research), v. 11: 515-521, 1961.

Preliminary results of observations of anti-rheumatic drugs are reported. In addition to observations of the well-known anti-edematous and anti-phlogistic action of these drugs, the following properties were noted: (1) Prednisolone: marked stimulation of the sugar metabolism in the granulomatous tissue, re-polarizing central analgetic, lissive, and local anesthetic effects; (2) Phenylbutazone: increase of sugar metabolism in the granulomatous tissue, re-polarizing, central analgetic, and lissive properties; (3) Aminopyrine: re-polarizing, central analgetic, spasmolytic, and lissive effects; (4) Sodium salicylate: central analgetic, spasmolytic, and lissive effects; and (5) Acetosalicylic acid: re-polarizing, spasmolytic, and central analgetic effects.

1159

Herman Föttinger Inst. für Strömungstechnik. Technische Universität, Berlin-Charlottenburg (Germany).

VORTEX DEVELOPMENT IN A SEPARATED BOUNDARY LAYER, by H. Schade and A. Michalke. May 31, 1962 [20]p. incl. illus. diagrs. table, refs. (Annual summary rept. no. 2) (AFOSR-3191) (AF 61(052)412) AD 282426 Unclassified

An attempt is made to explain the development of vortices in a separated boundary layer by investigating the axisymmetrical jet downstream of a special nozzle. According to stability theory, a shear profile of finite thickness is unstable against wavy disturbances of certain frequencies and wavelengths. If such wavy disturbances are present in the shear layer, it rolls up into discrete vortices according to Rosenhead's analysis. It is found that viscosity, though responsible for the formation of a shear layer, plays no significant role in the process of rolling up at high Reynolds numbers. The frequency of the natural fluctuations and the relation between frequency and wavelength for artificial excitation have been measured; the results are in good agreement with the theory. (Contractor's abstract)

1160

Herner and Co., Washington, D. C.

THE DETERMINATION OF USER NEEDS FOR THE DESIGN OF INFORMATION SYSTEMS, by S. Herner. [1962] [14]p. incl. refs. (AFOSR-3362) (AF 49(638)-1182) AD 407890 Unclassified

Also published in Information Systems Workshop: The Designer's Responsibility and His Methodology, Washington, Spartan Books, 1962, p. 47-60.

This study was conducted to establish, or restate, that user requirements, rigorously defined and evaluated, can be a factor in the design of information systems. Not only can real user requirements furnish insights as to what should be included in a projected system and how it will most probably be queried or searched, but, perhaps even more important, a knowledge of requirements can tell us what does not have to be included in the system and what it does not have to do. As also noted, the problem is first one of segregating and eliminating information that is not needed or is obtainable by other satisfactory means, second of defining information that is needed and is not otherwise obtainable, and third of defining the best channels for making this critical information available, currently or retroactively. These considerations, which are keyed to use-patterns, should form the basis for the design of any information storage and retrieval system.

1161

Herner and Co., Washington, D. C.

BASIC RESEARCH RESUMES 1961-1962. A SURVEY OF BASIC RESEARCH ACTIVITIES IN THE OFFICE OF AEROSPACE RESEARCH, 1962, 588p. (Rept. no. OAR-9) (AF 49(638)903) Unclassified

A set of indexed abstracts of research efforts supported by the Office of Aerospace Research is presented. These abstracts were written by various scientists in many different OAR organizations as part of an existing Department of Defense research management requirement, the DD-613, common to the 3 Services. Current DD-613's for all relevant OAR efforts were gathered together and turned over to the contractor, who in turn, edited them and organized them into 24 broad subject categories represented by the chapters of this book. The abstracts were then indexed by contractor, principal investigator, and contract number.

1162

Honeywell, Inc. Honeywell Research Center, Hopkins, Minn.

DENSITY AND ENERGY OF SURFACE STATES ON CLEAVED SURFACES OF GERMANIUM, by D. R. Palmer, S. R. Morrison, and C. E. Dauenbaugh. [1962] [6]p. incl. diagrs. refs [AF 49(638)597] Unclassified

Published in Phys. Rev., v. 129: 608-613, Jan. 15, 1963.

The channel technique has been successfully applied to measurement of the properties of cleaved germanium surfaces. A clean germanium surface is highly p type with the Fermi level near the valence band at the surface. This is brought about by acceptor-like surface states close to the edge of the valence band with a density of at least $1.5 \times 10^{12}/cm^2$. The density of these low-lying surface states decreases when the surface is exposed to oxygen. A comparison is made between results on cleaved surfaces and surfaces cleaned by ion bombardment. (Contractor's abstract)

1163

Honeywell, Inc. Honeywell Research Center, Hopkins, Minn.

THE OPTICAL AND ELECTRICAL PROPERTIES OF SINGLE CRYSTAL TELLURIUM. Final rept. May 31, 1962 [70]p. incl. illus. diagrs. tables, refs (AFOSR-2648) (AF 49(638)908) AD 281927 Unclassified

Work on zone purification and growth of doped and undoped single crystals is noted. Mechanical properties plastic damage, and identification of dislocations by etch pits are briefly covered. A section on optical properties notes the discovery of optical activity in tellurium, and details the work on intrinsic optical absorption, showing how this implies a "vertical" transition at the absorption edge, which is allowed for $E \perp C$ and forbidden for $E \parallel C$. The report recapitulates the progress made in understanding recombination processes in tellurium (both flaw processes and band-to-band processes). A section on transport effects outlines the extensive studies made of magnetoresistance, and the

recent measurements of hole mobility at low temperatures in doped and undoped crystals. Finally, some of the expectations concerning the energy band structure of tellurium are reviewed. (Contractor's abstract)

1164

Honeywell, Inc. Honeywell Research Center, Hopkins, Minn.

INTRINSIC OPTICAL ABSORPTION IN TELLURIUM, by J. S. Blakemore and K. C. Nomura. [1962] [6]p. incl. diagrs. table, refs. [AF 49(638)908] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 221, Mar. 26, 1962.

Measurements of intrinsic optical absorption have been made at 100 and 300°K by transmission techniques, covering a range of absorption coefficient from 0.01 cm^{-1} to 1900 cm^{-1} for radiation polarized E C, and to 5000 cm^{-1} for E⊥ C. These results suggest that the edge is set by vertical transitions, the transition being allowed for the polarization E⊥ C but forbidden for E C. Absorption above the intrinsic threshold is apparently influenced by electron-hole interaction, as postulated by Elliott. In the actual edge region, absorption falls off exponentially with decreasing photon energy, the steepness at 300°K being 197 ev^{-1} for E C and 267 ev^{-1} for E⊥ C. The steepness for each polarization increases by only 14% on cooling to 100°K. (Contractor's abstract)

1165

Hull U. [Dept. of Chemistry] (Gt. Brit.).

KINETICS OF HYDROGEN-OXYGEN AND HYDROCARBON-OXYGEN REACTIONS, by R. R. Baldwin. Final rept. Oct. 1961 - Oct. 1962 [6]p. incl. table refs. (AFOSR-4297) (AF EOAR-62-25) AD 291222 Unclassified

Attention was concentrated on 3 main aspects of H-O and HC-O reactions: (1) The completion of studies of the inhibition of the hydrogen-oxygen reaction by hydrocarbons, (2) studies of the effect of carbon monoxide on the hydrogen-oxygen reaction in aged boric-acid-coated vessels, and (3) studies of the water-sensitized oxidation of carbon monoxide (Contractor's abstract)

1166

Hull U. [Dept. of Chemistry] (Gt. Brit.).

THE SELF-INHIBITION OF GASEOUS EXPLOSIONS, by R. R. Baldwin, N. S. Corney and others. [1962] [9]p. incl. diagrs. refs. (AFOSR-64-2022) [AF EOAR-63-31] AD 614884 Unclassified

Also published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 184-192.

In discussing the conditions under which branched-chain reactions can give rise to isothermal explosions, it is usually assumed that the initial values of the parameters determine whether the system is stable or explosive. If, however, a reaction product can inhibit the reaction, substantial modification of the explosion condition may result. Two types of mechanism are discussed which illustrate this point. In the case of linear branching, it is shown that the original isothermal limit may be modified to a chain-thermal boundary. Thus, whereas ethane, propane, and butane inhibit the second explosion limit of H_2 and O_2 by direct chain-terminating reactions with H, OH, and O, methane and neopentane can inhibit only via their reaction products. Such products are formed in significant concentrations only after the uninhibited explosion boundary has been crossed and incipient explosion is developing. A variety of evidence supports the view that the character of the explosion changes from the original isothermal chain-branching explosion to a chain-thermal explosion with these 2 hydrocarbons. The second type of inhibiting mechanism, applicable when quadratic branching occurs, is exemplified by the self-inhibition of the H_2-O_2 reaction, as shown by the effect of withdrawal rate on the second limit. (Contractor's abstract, modified)

1167

Human Sciences Research, Inc., Arlington, Va.

SYSTEMS OF INFORMATION IN SMALL GROUP RESEARCH STUDIES, by J. E. McGrath. Apr. 1962, 28p. incl. diagrs. tables, refs. (Rept. no. HSR-TN-62/2-GN; technical rept. no. 7) (AFOSR-2416) (AF 49(638)-256) AD 276858 Unclassified

Also published in Human Relations, v. 16: 263-277, Aug. 1963.

Results clearly support the validity of the classification system for systematic organization of small group research information. The findings suggest that the small group literature contains 6 relatively distinct systems of information, namely; (1) structural characteristics of group members; (2) dynamic characteristics of members; (3) structural properties of the group itself; (4) behavioral or dynamic properties of the group; (5) structural characteristics of the group's environment; and (6) environmental processes. The findings of the validation study indicate that variables within each of these 6 subsystems show consistent interrelationships, while relatively few significant relationships hold between variables from different subsystems. (Contractor's abstract)

1168

Human Sciences Research, Inc., Arlington, Va.

A SUMMARY OF SMALL GROUP RESEARCH STUDIES,

by J. E. McGrath. [Final rept.] June 1962 [146]p. incl. refs. (Rept. no. HSR-TN-62/3-GN) (AFOSR-2709) (AF 49(638)256) AD 276860 Unclassified

The main purpose of this research program has been to develop and apply methods for systematic classification and integration of research information contained in small group research investigations. In the present report an attempt is made to formulate a series of broad, empirically-supported generalizations which have been induced from the information compiled during the program. Appendix A presents in detail the development of a simplified classification system, using substantive rather than operational labels for variables, and applies this system to the recompilation of small group research information collected during the program. Chapter I describes the revised, substantively based classification of variables. Chapter II presents a summary of the general propositions, or major empirical generalizations induced from the research information. The third and final chapter discusses some of the implications of these results for small group research and theory.

1169

Human Sciences Research, Inc., Arlington, Va.

INTEGRATION OF SMALL GROUP RESEARCH INFORMATION: PROGRAM REPORT, by J. E. McGrath. June 1962 [6]p. (AFOSR-3009) (AF 49(638)256) Unclassified

The aims and accomplishments of a research program designed to develop and apply methods by which research findings from different small group studies could be combined into an integrated body of scientific knowledge, are described. The first task of the program was development of a comprehensive system for classifying small group research information, which was then applied to approx 250 small group research studies, yielding a detailed set of coded information on nearly 12,000 research relationships contained in the studies. Among the products of this program which are considered to be of direct usefulness to researchers in this field are: a rather extensive bibliography on small group research, brief annotations of each of the 250 studies coded, and a systematic catalog of the major variables of the small group research field. The variable catalog describes the operational and substantive properties of each major variable contained in the coded studies, actuarial information about the frequency and distribution of its use, and detailed evidence about its relationships with other major variables of the field. A list of reports resulting from this program is appended.

1170

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

PRESSURE EFFECTS IN LUMINESCENCE [PART I], by L. Reiffel. May 26, 1958, 17p incl. illus. diagrs. (AFOSR-3477) (AF 49(638)113) Unclassified

Presented at meeting of the Amer Phys. Soc., Chicago, Ill., Mar. 27-29, 1958.

Abstract published in Bull. Amer. Phys. Soc., v. 3: 137, Mar. 27, 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): 697-704, 1960.

For abstract see item no. IIT. 14:002, Vol. II.

1171

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

ORGANIC SEMICONDUCTORS, by C. Sosnovsky. Final rept. Mar. 15, 1959-Mar. 14, 1962. 56p. incl. diagrs. tables, refs. (Technical rept. no. ARF 3142-12) (AFOSR-2663) (AF 49(638)576) AD 278123 Unclassified

The dielectric, spectroscopic, and photoconductive properties of selected addition compounds and their donor and acceptor components were investigated. The study of dielectric properties entailed measurements of dielectric losses, dielectric constants, and dielectric resistivities on compressed powders. The data indicate that polarization effects caused by migrating charges are probably responsible for the high loss regions found at low frequencies At higher frequencies bimodal temperature-dependent loss curves were found for some addition compounds. The spectral response of photoconduction in single crystals of 2 addition compounds and their components was measured as a function of field direction, applied voltage, light intensity, and time of illumination. The results show that space-charge build-up effects set up by travelling charge carriers dominate the conduction mechanism. The correlation of spectral response data with spectroscopic data was variable. (Contractor's abstract)

1172

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

THERMOCHEMICAL AND STRUCTURAL STUDIES ON ALKALI METAL OZONIDES. by A. J. Kacmarek Final rept. [1962] 22p incl. diagrs tables, refs. (Rept. no. ARF 3151-11) (AFOSR-2983) (AF 49(638)618) AD 427772 Unclassified

Physical and chemical properties of alkali metal ozonides were determined. Two new alkali metal-like ozonides, $(CH_3)_4NO_3$ and NH_4O_3, were prepared and also characterized The conventional method of preparing ozonides was improved Three solvents which dissolve ozonides were found, liquid ammonia, methylamine, and dimethylformamide (in order of decreasing efficiency). Electron paramagnetic resonance studies revealed unpaired electrons of the same nature in the ozonides. Visible absorption spectra of the ozonides showed λ_{max} near 450 mμ and a fine structure of 5 other peaks. New apparatus was designed for powder x-ray diffraction analysis of KO_3 The crystal structure of KO_3 was not isostructural with KN_3. NaO_3 probably exists in at least 2 crystalline forms. One is soluble in liquid ammonia and unstable at room temperature, while the other is insoluble in liquid ammonia and stable at room temperature. (Contractor's abstract modified)

1173

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

FEASIBILITY OF NEUTRON DIFFRACTION STUDIES IN HIGH PRESSURE, by G. H. Wolfe and L. Reiffel. Final rept. May 10, 1962, 21p incl. illus. diagrs. table. (Rept. no. ARF 1183-4) (AF 49(638)1010) AD 277846 Unclassified

Studies were conducted to establish the technical feasibility of obtaining neutron diffraction data on specimens under high hydrostatic pressure. Laue patterns of RbI and RbCl were obtained at pressures up to 80, 000 psi in a uniquely designed pressure bomb. The RbI transformed completely at 60, 000 psi, but only an incomplete transition was observed in RbCl. There are indications of possible differences in the transformation mechanism for these materials. It is concluded that neutron Laue patterns are feasible at pressures up to 80, 000 psi and that the method could be extended to perhaps 150, 000 psi. (Contractor's abstract)

1174

Illinois Inst. of Tech. Armour Research Foundation, Chicago

DISCRIMINATORY ANALYSIS APPLIED TO CLASSIFICATION OF SEISMIC PHENOMENA, by P. Gunther. Final rept. May 1, 1961 - Apr. 30, 1962, June 30, 1962. 76p. incl. illus. diagrs. tables, refs. (AFOSR-3172) (AF 49(638)1066) AD 458000 Unclassified

This study proposes a mathematical-statistical model for discrimination between earthquakes and nuclear explosions. The initial formulation defines the source parameters relating to geometry of the focus and of the source mechanism, the earth layering and heterogeneity parameters, and the principal types of waves that are propagated. A method of analysis of seismograms is proposed which can extract information from

sources not ordinarily used, namely arrival times and amplitudes of secondary body phases. The principal problem areas relating to identification of phases and precision station calibration are discussed in detail. Finally, methods for probability evaluation of the discrimination procedures are discussed. (Contractor's abstract)

1175

Illinois Inst. of Tech. [Dept. of Chemistry] Chicago.

ELECTRONIC ENTROPY IN LIQUID METAL SOLUTIONS, by L. M. Webber. Jan. 1962. 53p. incl. diagrs. tables, refs. (AFOSR-1353) (AF 49(638)346) AD 282435 Unclassified

The entropy of mixing of binary metallic solutions is studied. The contribution to the entropy of mixing arising from the change in the statistical distribution of electrons is the primary interest when 2 metallic components were mixed. The general nature of the deviations of the measured entropy of the mixing from the ideal behavior is recognizable from the nature of the assumptions involved in reducing the complete statistical formulation to the simple form of equation, which is based on the assumption of a completely random distribution of the 2 components of the solution. For metals, theoretical treatments indicate that the electronic heat capacity is linearly dependent on the absolute temperature. Consequently, integration to the temperature of measurement of the thermodynamic entropy is possible and can lead to the contribution of the electrons to the entropy of mixing. (Contractor's abstract)

1176

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

DEFORMATION AND DUCTILE FRACTURES OF METALS IN TORSION AND TENSION, by N. H. Polakowski and S. Mostovoy. Final rept. Feb. 1962 [67]p. incl. illus. diagrs. refs. (AFOSR-2276) (AF 49(638)308) Unclassified

The various types of shear fractures are classified and it is suggested that the cup-and-cone type occurs when an axisymmetrical stress gradient or a likewise orientation exists. Attention is also drawn to the constancy of the fracture stress within a broad range of initial prestrain by methods other than tension. Transient deformation instability in torsion is studied. The increase of ductility of work hardened FCC metals at low temperatures is discussed and it is concluded that this spectacular change is caused by the increase of the strain-hardening exponent. The Swift fracture in tension is shown to often deviate from the plane of the torsional prestrain helix. It was possible to localize a Swift fracture to a single shear band which resulted in an "end mill" type fracture which progressed violently without penetrating, however, into the metal outside the band. (Contractor's abstract, modified)

1177

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

DIRECTIONAL PROPERTIES OF A MODIFIED 5% Cr TOOL STEEL AUSFORMED BY TORSION, by R. G. Toth and N. H. Polakowski. [1962] [9]p. incl. illus. diagrs. table. (AFOSR-4012) (AF 49(638)308) Unclassified

Also published in Trans. Amer. Soc. Metals, v. 55: 426-428, Sept. 1962.

A modified 5% Cr tool steel (0.35% C, 5% Cr-Mo-W-V) was quenched into a hot bath at 800° to 900° F, twisted in the austenitic bay range and air cooled to produce martensite. Room-temperature torsion tests in the pretwist direction showed a nominal fracture shear stress of up to 320,000 psi compared with 245,000 after ordinary hardening. The fracture changed from brittle (45°) to the shear type after pretwisting in excess of $\gamma_p = 1$. Reversed torsion or axial tension on pretwisted material invariably gave brittle fractures and a lower fracture stress than quenching alone. These results are indicative of a transverse weakness of ausformed steel. On the other hand, strengthening by torsion may be useful in applications involving substantially unidirectional torsional loads. (Contractor's abstract)

1178

Illinois U. [Charged Particle Lab.] Urbana.

CHARGED PARTICLE PROPULSION: A DOUBLE ENERGY-CONVERSION PROBLEM, by C. D. Hendricks. [1962] [11]p. incl. illus. diagrs. (AF AFOSR-63-107) Unclassified

The electric propulsion of space vehicles is a problem which, at first glance, is rather straightforward and simple. A beam of charged particles is formed, accelerated by an electric field, neutralized, and permitted to leave the vehicle in much the same manner as does the high-velocity gas from a jet engine of a chemical rocket. Therefore, it is necessary to substitute electrical means of accelerating the particles for chemical means and to change the particles from hydrocarbons, water, oxides of carbon or nitrogen, and other molecules to atoms or ions of cesium, rubidium or other alkali metals or to multiatomic particles of carbon, mercury, glycerol or other convenient material. This report discusses: (1) energy conversion concept, (2) electrical mechanical conversion, (3) methods of producing charged particles, (4) efficiency considerations, (5) electrical spraying of liquids, and (6) specific-charge distributions.

1179

Illinois U. [Charged Particle Lab.] Urbana.

CLASSICAL PHYSICS IN MODERN SPACE PROPULSION: HEAVY PARTICLE BEAM FORMATION BY ELECTRICAL SPRAYING OF LIQUIDS, by C. D. Hendricks. [1962] [11]p. (AF AFOSR-63-107) Unclassified

A short introduction is given to some of the problems of electric propulsion in order to emphasize the classical aspects of this modern field of research and development. A discussion is presented of the application of electrical spraying of liquids to the problems of modern electric propulsion of space vehicles. Recent experimental and theoretical results are discussed, including high-speed photomicrography and mass spectrometry, and the advantages of heavy charged particle propulsion systems are pointed out. (Contractor's abstract)

1180

Illinois U. [Coordinated Science Lab.] Urbana.

ANTENNA IMAGE QUALITY CRITERIA, by J. J. Myers. Dec. 1958 [72]p. incl. diagrs. tables, refs. (Rept. no. R-108) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) Unclassified

This report is the first of a series of 3 reports giving the results of a study of antenna resolution and image quality as related to the aperture illumination. The results of a mathematical evaluation based on various image quality criteria that have been suggested by antenna and optical theory are given. Each of the criteria was analyzed to determine its essentials and to find the relationships between the various criteria. The results of this analysis led to a catalog of image quality criteria useful in antenna theory. An investigation was made of the class of aperture illuminations given by $(1 + A \cos 2\pi x/L)$, where x is the aperture coordinate, L is the antenna length, and A is an aperture illumination parameter defined over the interval (-1, 1). The optimum of the class was determined for each of the criteria. The study led to the conclusion that image quality is not highly sensitive to aperture illumination and that a uniform illumination is close to optimum for an important class of applications. (Contractor's abstract)

1181

Illinois U. [Coordinated Science Lab.] Urbana.

ANTENNA RESOLUTION AS LIMITED BY ATMOSPHERIC TURBULENCE, by C. M. Angulo and J. P. Ruina. July 1957 [37]p. incl. diagrs. table (Rept. no. R-96) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-56695) Unclassified

Spatial variations of the index of refraction of the atmosphere introduce fluctuations in the phase and amplitude of a wave propagating through it. The effect of these fluctuations on the resolution capability of microwave antennas is discussed. The measure of resolution used in the calculations is the beamwidth which is defined as the square root of the second moment about the mean of the normalized antenna pattern. This measure simplifies the calculations greatly and results in a simple expression for the beam broadening due to the variation of the refractive index. This broadening is dependent on the distance to the target, the scale of the turbulence, the variance of the refractive index and is relatively insensitive to the shape of the spatial correlation function of the refractive index. Measurements by others, of the nature of the refractive index spatial variation, are then used to obtain numerical estimates of the ultimate resolution capability of a microwave antenna as limited by atmospheric turbulence. (Contractor's abstract)

1182

Illinois U. [Coordinated Science Lab.] Urbana.

ASSESSMENT OF ANTENNA IMAGE QUALITY BY A MECHANICAL OBSERVER, by J. J. Myers. Dec. 1958 [36]p. incl. diagrs. table. (Rept. no. R-110) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) Unclassified

An experimental evaluation of the effect of aperture illumination on the resulting image of a high-resolution antenna was made using a mechanical observer for assessing quality. The mechanical observer consisted of ILLIAC, the University of Illinois digital computer, programmed for the purpose. The evaluation was intended to complement an experimental evaluation of antenna image quality made by human observers, and a mathematical study of quality criteria. A close connection between image quality and aperture illumination was found by the mechanical observer as measured by its ability to analyze the images presented to it for assessment. The data show that a uniform aperture illumination is close to optimum. This result agrees with the result obtained in the experiment of item 1184. Results obtained from an assessment of a representative class of aperture illuminations are presented, and a detailed description of the mechanical observer and a block diagram of the logic used are given. (Contractor's abstract)

1183

Illinois U. [Coordinated Science Lab.] Urbana.

HUMAN PERFORMANCE IN INFORMATION TRANSMISSION PART VI. EVIDENCES OF PERIODICITY IN INFORMATION PROCESSING, by L. G. Augenstine. Dec. 1958 [37]p. incl. diagrs. tables. (Rept. no. R-75) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) Unclassified

Information transduction requires at least 3 operations; data input, data processing and responding. An

attempt has been made to specify some of the properties associated with data processing. Subjects were presented a variety of tasks chosen so that: (1) In the majority, either a single response or very simple responses were required, (2) The stimuli consisted of simple and familiar symbols or situations, (3) Each response could be formulated by making a sequence of simple unequivocal decisions, (4) Each response required many such decisions and (5) The tasks were self-paced. Analysis of the response times indicated that the performance of these simple tasks is undoubtedly quantized in units of 100 msec. However, it is not clear if this is the fundamental quantum associated with data processing. Rather, this may represent a grouping of 3 more fundamental quanta of 33 msec duration and within which one act of either data processing or input can be performed. Also there are indications that a 265 msec periodicity, possibly linked to eye movements, is associated with those tasks requiring vertical scanning.

1184

Illinois U. [Coordinated Science Lab.] Urbana.

OPTICAL SIMULATION OF ANTENNA IMAGES, by J. J. Myers and B. D. Elliot. Dec. 1958 [28]p. incl. illus. diagrs. table, refs. (Rept. no. R-109) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-56695) Unclassified

An experimental evaluation of antenna image quality as related to the aperture illumination of a high resolution antenna was made. An optical method of simulating antenna images was employed to form photographs that were evaluated by human observers. A representative class of illuminations was studied and the optimum of the class determined. The conclusion drawn from the evaluation was that antenna image quality is not highly sensitive to aperture illumination and that a uniform illumination is close to optimum for the import class of applications investigated. A detailed description of the experimental procedure is given and reproductions of some of the images analyzed are included. The results of the experiment are presented in the form of graphs showing relative image quality as a function of the variation in the antenna illumination parameter.

1185

Illinois U. [Coordinated Science Lab.] Urbana.

BINARY QUANTIZATION OF SIGNAL AMPLITUDES: EFFECT FOR RADAR ANGULAR ACCURACY, by D. H. Cooper. May 1959 [26]p. incl. diagrs. (Rept no. R-102) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) Unclassified

An investigation determining the limits that receiver noise imposes upon the accuracy with which the angular position of a target may be estimated by means of a pulsed search radar, is extended to determine additional accuracy limitations imposed by the quantization of signal strengths prior to angle estimation. The results are presented in graphs. For many cases of practical interest, the additional limitation in accuracy may be neglected. (Contractor's abstract)

1186

Illinois U. [Coordinated Science Lab.] Urbana.

AN ELEMENTARY DESCRIPTION OF TASC, A TRACKING AND SORTING COMPUTER, by J. Divilbiss. June 1959 [31]p. incl diagrs. tables. (Rept. no. R-114) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-56695) Unclassified

The tracking logic of TASC consists of a number of elementary arithmetic operations which individually are easily defined. Three of these are: (1) Initiation, which starts a track on the basis of a radar position report; (2) Association, which corrects an existing track as the result of a position report; and (3) Extrapolation, which is essentially dead reckoning between position reports. These operations are introduced by simple examples which show the interdependence of the operations. It is this interdependence which is the essential part of tracking logic. In the second part of the report, more complicated tracking problems are treated. Attention is given to logical circuits which have been added to TASC to deal with turning tracks. Certain other aspects of the machine design such as the selection of tracking parameters and the sequencing of operations are covered. (Contractor's abstract)

1187

Illinois U. Coordinated Research Lab., Urbana.

SIGNAL AMPLITUDE LIMITING AND PHASE QUANTIZATION IN ANTENNA SYSTEMS, by D. L. Bitzer. Dec. 1959, 97p. 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-56695) Unclassified

The effects of 2 different types of quantization on the antenna system which can be used to steer and focus with the required speed are investigated. The first type of quantization consists of introducing discrete phase shifts in the signals at each of the antenna elements such that the antenna beam can be steered and focused electrically. The second type of quantization investigated is described with the use of the complex plane and is non-linear. The investigation is limited to a one-dimentional linear array with the elements equally spaced.

1188

Illinois U. Coordinated Science Lab., Urbana.

ELECTROMAGNETIC MASS AND THE INERTIAL PROPERTIES OF NUCLEI, by C. W. Sherwin and R. D. Rawcliffe. Mar. 14, 1960 [19]p. incl diagr. (Rept. no. I-92) Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) AD 625706 Unclassified

According to the theory of relativity the inertial mass of any physical system should be a scalar quantity (no matter how distorted its electromagnetic structure) and the excess inertial mass of electromagnetic origin should not be observable. Experimental evidence on both these points was examined for nuclei. It is found that the inertial mass of a distorted nucleus, as measured by a mass spectrometer, has no observable asymmetry to an accuracy of 1 part in 100 of the asymmetry which is calculated to exist as a consequence of the electromagnetic energy. It is found that a comparison of nuclear mass differences (as measured by the mass spectrometer and by nuclear reactions) shows that the 'excess' electromagnetic inertial mass is not observable, to an accuracy of 1 part in 600. (Contractor's abstract, modified)

1189

Illinois U. Coordinated Science Lab. Urbana.

RESONANT BINARY SHIFTING REGISTER, by I. Weissman. Thesis, 1960, 152p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) Unclassified

The principal objectives of the research described herein are: (1) to investigate the underlying principles of operation of the SRSR (Synchronous Resonant Shifting Register), and (2) to develop an experimental SRSR and demonstrate its feasibility. From the standpoint of simplicity and economy it seems clear that one would like the state of a single capacitor at a given time to represent 1 bit of information. In addition it is desirable that the switches be the simplest possible devices capable of performing the required switching function at the required speed.

1190

Illinois U. Coordinated Science Lab., Urbana.

BASIC RESEARCH IN HIGH POWER MICROWAVES, PLASMAS, PARTICLE BEAMS, CONTROL SYSTEMS AND HIGH VACUUM ELECTROPHYSICS, (Unclassified title) by D. Alpert. Final rept. Aug. 31, 1961. (AFOSR-1916) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) Confidential

1191

Illinois U. Coordinated Science Lab., Urbana.

TUNNEL DIODE DETECTOR, by T. Yasui and W. Mayeda. May 1962, 34p. incl. illus. diagrs. refs. (Rept. no. R-128) (AFOSR-3426) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 282917 Unclassified

By use of a tunnel diode, it is possible to design a detector which is capable of amplifying a detected signal. Suppose input signal is an amplitude modulated signal whose modulating signal is $e_s \sin \omega_i t$ and the degree of modulation is very small. From the experimental results, the insertion gain,

$$g_s = \left| \frac{e_o}{e'_o} \right|,$$

is larger than 14 where e_o is the peak value of output signal corresponding to e_s with a tunnel diode being active and e'_o is the peak value of output signal corresponding to e_s with the tunnel diode being shorted.

1192

Illinois U. Coordinated Science Lab., Urbana.

PROPERTIES OF SOME ALL-POLE TRANSFER FUNCTIONS, by D. A. Calahan. [1962] [12]p. incl. diagrs. tables. (AFOSR-4223) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-126; Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 293153 Unclassified

The simplicity in realizing all-pole functions and their relative insensitivity to element change has caused a study of such transfer functions with both Tchebycheff and weighted passband responses to be made. Certain closed form expressions associated with these functions are found. A simple relationship between the residues at the poles of a Tchebycheff all-pole transfer function and the poles themselves is derived. A variation on the work of Bennett, Helman, and others is shown to yield an all-pole function with weighted passband response. (Contractor's abstract)

1193

Illinois U. Coordinated Science Lab., Urbana.

THE ELECTRON NUCLEAR DOUBLE RESONANCE SPECTRUM OF AN F-CENTER IN ALKALI HALIDES, by T. E. Feuchtwang. [1962] [9]p. incl. diagrs. table. (AFOSR-64-2332) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-65122) Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 740-748, 1963.

The spin-Hamiltonian describing the hyperfine interaction of an F-electron with all nuclei in the lattice, in the presence of a constant and uniform magnetic field is reduced to an equivalent nuclear spin-

Hamiltonian. Because of the relative size of the isotropic magnetic hyperfine constant and the electric quadrupole coupling constant it is necessary to include in this calculation the contribution of the isotropic interaction to second order in the electron spin operator. This fact has 2 interesting consequences: (1) The electron nuclear double resonance spectrum calculated from the effective spin-Hamiltonian is sensitive to the sign of the product of the nuclear g-factor and the electric quadrupole coupling constant. (2) If one accounts for the physical equivalence of pairs of nuclei mapped into each other by an inversion in the center of the vacancy, then the effective Hamiltonian includes an electron mediated indirect coupling between the pairs of equivalent nuclei. This in turn leads to a considerably larger number of electron double resonance lines than predicted by Feher's theory. The theory was tested by fitting an observed spectrum. The agreement was remarkable. The determination of the sign of the electric quadrupole coupling was completely unambiguous. (Contractor's abstract)

1194

Illinois U. Coordinated Science Lab., Urbana.

THE ELECTRIC FIELD GRADIENT SEEN BY NUCLEI IN THE FIRST FEW SHELLS ABOUT THE VACANCY ASSOCIATED WITH AN F-CENTER IN ALKALI HALIDES, by T. E. Feuchtwang. [1962] [6]p. (AFOSR-64-2333) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122) Unclassified

Also published in Paramagnetic Resonance: Proc. of the First Internat'l. Conf., Jerusalem (Israel) July 16-20, 1962), New York, Academic Press, v. 2: 749-754, 1963.

Three factors contribute to the electric field gradient tensor seen by nuclei in the neighborhood of the negative ion vacancy associated with an F-center: (1) the net positive charge associated with the vacancy, (2) the F-electron charge density, and (3) the polarization of the lattice. Assuming that the theoretical value of the Sternheimer nuclear antishielding factor is correct, then the contribution of the first term is known. The contribution of the second term can be estimated from the magnetic dipole-dipole coupling constant of the hyperfine interaction between the F-electron and a given nucleus, provided one has an estimate of the spherically symmetric part of the F-electron charge density. The electron nuclear double resonance data lead to an experimental determination of the sign and magnitude of the field gradient tensor seen by a given nucleus. Hence, the sign and magnitude of the field gradient due to the polarization effects can be estimated. Assuming that the only important effects are associated with ion displacement, it is shown that the sign of the polarization f. g. is the same as that of the displacement of the ions i. the first shell (inward displacement is positive). Theoretical calculations for LiF and experimental data for KCl show that polarization effects are important and that ions displace into the vacancy. (Contractor's abstract)

1195

Illinois U. Coordinated Science Lab., Urbana.

ADSORPTION OF MOLECULAR GASES ON SURFACES AND ITS EFFECT ON PRESSURE MEASUREMENT, by D. Lee, H. Tomaschke, and D. Alpert. [1961] [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-85122) Unclassified

Also published in 1961 Trans. Eighth Nat'l. Vacuum Symposium combined with Second Internat'l. Cong. on Vacuum Science and Technology, Washington, D. C. (Oct. 16-19, 1961), ed. by L. E. Preuss. New York, Pergamon Press, v. 1: 151-159, 1962.

Measurements of the rate of adsorption of various molecular gases on clean metallic surfaces have been related to measured values for the pumping speeds of a well-outgassed ionization gage. Estimates have been made of the nature and magnitude of errors in pressure measurement attributable to adsorption on the surfaces of ionization manometers. For some gases, such as nitrogen, the necessary correction is negligible; for others, such as carbon monoxide, the correction may be large and unpredictable. Experiments to detect surface ionization in a normally-outgassed Bayard-Alpert gage have failed to yield a detectable effect, even when the electrodes have been subsequently saturated with carbon monoxide. In general ultra-high vacuum ion ionization manometers, whether for total or partial pressures, properly measure the volume density within the gage. However, if the conductance to the system volume is small, the pressure within the gage may not be identical to that in the system. Reasonable corrections can be made if the reactions between gases and gage surfaces are understood. (Contractor's abstract)

1196

Illinois U. Coordinated Science Lab., Urbana.

CONTRIBUTIONS FOR THE EASTON CONFERENCE ON OCEAN WAVE SPECTRA. I. ESTIMATION OF THE SPECTRUM FUNCTION FOR SMALL WIND WAVES. II. PREPARED DISCUSSION OF CONFERENCE PAPERS, by B. L. Hicks. Mar. 1961 [27]p. incl. diagrs. tables, refs. (Rept. no. M-94) (Sponsored jointly by Air Force Office of Scientific Research Office of Naval Research and Signal Corps under DA 36-039-sc-85122) Unclassified

In the studies of wave spectra, values of mean square energy e_m in octave-wide frequency bands were obtained in "real time" measurements through the use of

analog devices. Illiac, the University of Illinois digital computer, was then used to effect a least squares fit to an integral of a parameterized spectrum function $\phi_c(\lambda_n)$ and to estimate the probable errors of the parameters λ_n. The CSL data covers the ranges $0.15 \leq V \leq 10.2$ m/sec, $5 \leq F \leq 625$ m, and $0.5 \leq f \leq 16$ cps, where V, F, and f are the average wind speed, average fetch, and wave frequency, respectively. A similar analysis was made of Burling's data, which covers a smaller range but more accurately. The least squares calculation of the values of the parameters λ_n and their probable errors ν_n affords an objective basis for comparing the 2 sets of data with each other and with data from other sources, for estimating the uncertainty of derived quantities such as the rms wave elevation, and for specifying for the first time the effect of wind speed and fetch upon the energy spectra of small waves on the water over a large range of each independent variable. (Contractor's abstract)

1197

Illincis U. Coordinated Science Lab., Urbana.

EQUIPMENT REPORT ON AN MRO QUANTIZED VIDEO PROCESSOR AND PRINCIPAL DELAY NETWORK, by B. Voth. Mar. 1961 [49]p. incl diagrs (Rept. no. I-101) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) Unclassified

The particular objective of this report is to explain in detail the operation of the video processor and the multi-channel delay network. In reaching this objective, descriptions of circuit functions accompanied by block diagrams will be given. The descriptions will encompass circuit functions which seem to be individual in nature and will be presented in an order which is thought to lead most easily to an understanding of the processor. That is, for example, pulse generation and frequency control will begin the description, thereby giving a feeling for timing and delay helpful in the understanding of certain subsequently discussed circuitry. Also to facilitate the continuity of the discussion of individual circuits, an abbreviated block diagram of the processor is now shown.

1198

Illinois U. Coordinated Science Lab., Urbana.

A NOTE ON A METHOD OF DETERMINING PERTINENT AUGMENTATION OF POLYNOMIALS, by F. Miyata. Mar. 1961, 14p. incl. table. (Rept. no. R-125) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) Unclassified

Miyata's method on synthesis of driving point impedances brought about the problem of determining pertinent augmentation of polynomials. On this point, D. A. Calahan has offered 1 method. Assume that $N_1(z)$ is a given polynomial and $N_2(z)$ is a pertinent augmentation such that,

$$N_3(z) = N_1(z) \cdot N_2(z) = b_r z^r$$

where $b_r \geq 0$ for all r. However, this method requires the knowledge of z_1 (the zeros of $N_1(z)$) and this makes the method impractical. This report shows that the use of zeros of the original polynomials should be avoided, if it is possible.

1199

Illinois U. Coordinated Science Lab., Urbana.

ON ORIENTED COMMUNICATION NETS, by W. Mayeda. June 1961, 25p. incl diagrs. (Rept. no. R-128) (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. Trans. on Circuit Theory, v. CT- 9: 261-7, Sept. 1962.

This paper gives the solution to an important problem associated with an oriented communication net which is to obtain the maximum number of different values of terminal capacities in the net. Tang and Chien give an interesting condition for realizability of terminal capacity matrices of oriented communication nets. This paper shows that this condition is not sufficient. A sufficient condition for realizability of terminal capacity matrices of oriented communication nets is given which is more general than the necessary and sufficient conditions for the non-oriented communication net. The net whose terminal capacity matrix satisfies the above sufficient condition can have at most 2 (v-1) different terminal capacities where v is the number of vertices in the net. Notice that there are at most v-1 different terminal capacities in a non-oriented communication net. (Contractor's abstract)

1200

Illinois U. Coordinated Science Lab., Urbana.

SYNTHESIS OF THRESHOLD NET WORKS BY ALOGIC FUNCTIONS, by W. Mayeda. Mar. 1961, 27p. incl diagrs. refs. (Rept. no. R-124) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122) Unclassified

By the use of functions called alogic functions consisting of logic operations as well as algebraic operations, the synthesis of threshold or majority networks becomes simple especially for the realization of a switching function by a single threshold or a single majority element. The first section introduces a particular

threshold element called a W-element and shows that W-elements and scalar multipliers are sufficient to represent any threshold or majority networks. The second section shows the properties of alogic functions and clarifies that the synthesis of threshold or majority networks is equivalent, to obtain a suitable alogic function from a switching function. The third section gives a rather simple method for the realization of a switching function by a single threshold or a single majority element. An n-dimensional cube associated with n switching variables and n-1 dimensional hyperplanes has been used by others for the investigation of the properties of threshold or majority elements. In the last section, it is shown that an alogic function of the form $\Sigma a_i x_i - k$ represents an n-1 dimensional hyper-plane. The extension of applications of alogic functions to synthesis of sequential circuits is promising. (Contractor's abstract)

1201

Illinois U. Coordinated Science Lab., Urbana.

A TECHNIQUE OF LINEAR SYSTEM IDENTIFICATION USING CORRELATED FILTERS, by W. W. Lichtenberger [1961] [17]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) Unclassified

Presented at Joint Automatic Control Conf., Colorado U., Boulder, June 28-30, 1961.

Published in I. R. E. Trans. on Automatic Control: v. AC-6: 183-199, May 1966.

A technique for measuring the impulse response of linear processes while they are on line is described. A testing signal and correlating filter are employed after the manner of Turin. Such a procedure requires no multiplier, and the output of the filter is the impulse response as a continuous function of real time To reduce accompanying output noise, the method of adding coherently the results of a number of tests made in succession is proposed and applied to the measurement of a member of an ensemble of slowly varying impulse response. Optimum design of both the correlating filter and the necessary test signal is determined on the basis of minimum mean-square error of the resulting estimate. The general results are applied to the case of a single, slowly time-varying process. In addition to optimum design, normalized curves showing the optimum number of tests for a particular mode of variation are included. A second application is made to the problem of measuring a member of an ensemble of fixed process. (Contractor's abstract modified)

1202

Illinois U. Coordinated Science Lab., Urbana.

APPARATUS FOR THE STUDY OF EJECTION OF AUGER ELECTRONS FROM SOLID SURFACES, by F. M. Propst and E. Lüscher. [1962] [6]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-85122) Unclassified

Published in Rev. Scient. Instr., v. 34: 574-579, May 1963.

A stainless steel apparatus for the study of the ejection of electrons from solid surfaces is described. The bakeable vacuum system consists of three sections and is capable of maintaining pressure in the 10^{-10} mm Hg region. Each of the three sections is pumped via a liquid nitrogen trap by a mercury diffusion pump. Typical pressures under operating conditions are 10^{-9} mm Hg in the target section and 10^{-6} mm Hg in the ion-source section. The ion-lens system is described and a convenient method of construction of ion lenses is illustrated. A description of a simple analog computer that determines the yield and the energy distribution of the ejected electrons is given.

1203

Illinois U. Coordinated Science Lab., Urbana.

AUGER EJECTION OF ELECTRONS FROM TUNGSTEN (Abstract), by F. M. Propst and E. Lüscher. [1962] [1]p. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research] and Signal Corps under [DA 36-039-sc-85122]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 316, Apr. 23, 1962.

An apparatus based on the experience of Hagstrum has been used to study the ejection of electrons by low-energy noble gases and hydrogen ions from tungsten surfaces. The total yield for H^+ on clean polycrystalline tungsten is 2.7%, which is in reasonably good agreement with the theoretically predicted value of 3.5%. The results for He^+ have been compared with those reported by Hagstrum and are in substantial agreement.

1204

Illinois U. Coordinated Science Lab., Urbana.

AUTOMATIC AIR TRAFFIC CONTROL. PART I. A PROJECTED SYSTEM, by L. S. Kypta. Aug. 1962 [37]p. incl. diagrs. (Rept. no. R-145) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 286887 Unclassified

The automatic air traffic control system described consists of automatic control centers for en route control and small satellite computers for approach-departure control. Each automatic control center is composed of 5 automatic sections providing the following functions: (1) position gathering and tracking

(2) internal communication (3) manual input and display, (4) control, and (5) information storage. An automatic center is capable of controlling over 1000 aircraft simultaneously. Each satellite computer is intended to control approaching and departing aircraft for one airport and is capable of controlling 50 flights simultaneously. The goal in the design of the system is to provide a system that in no way hinders traffic flow and also is safe and simple to use. To achieve this goal, it is necessary to automate all processes in which information flows in large quantities or is rapidly changing. The most important process falling in this category is decision making; consequently, decision making has been automated. All processes in which information is slowly changing or infrequently exchanged are to be executed manually. (Contractor's abstract)

1205

Illinois U. Coordinated Science Lab., Urbana.

AUTOMATIC AIR TRAFFIC CONTROL. PART I. A PROJECTED SYSTEM, by L. S. Kypta. Nov. 1962 [37]p. incl. diagrs. (Rept. no. R-145-A) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 611096 Unclassified

For abstract see item no. 1204, Vol. VI.

1206

Illinois U. Coordinated Science Lab., Urbana.

COLLISION CROSS SECTION OF SLOW ELECTRONS AND IONS WITH CESIUM ATOMS, by C. L. Chen and M. Raether. May 1962, 23p. incl. illus. diagrs. refs. (Rept. no. R-137) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 278563 Unclassified

Also published in Phys. Rev., v. 128: 2679-2683, Dec. 15, 1962.

Microwave interferometry is adopted to measure the effective collision cross section for momentum transfer $\bar{Q}_m$ of thermal electrons (of mean energies of ~0.06 to 0.071 ev) with cesium atoms in the afterglow of pure cesium and helium-cesium discharges. The momentum transfer cross section $\bar{Q}_m$ is found to be best represented by $1.61 \times 10^{-10} T_e^{-1} - 9.03 \times 10^{-12} T_e^{-1/2} + 2.03 \times 10^{-13}$ cm^2 in the temperature range of approximately 450° to 550°K. The energy dependence of the elastic electron-cesium-atom collision probability for momentum transfer is determined to be $P_m = 997 u^{-1} - 4810 u^{-1/2} + 7230$ cm^{-1} where u is the energy of the electrons in electron volts. This shows a smooth tendency to join Brode's data at higher electron energies. Mobilities of Cs^+ ions in helium and in cesium have been determined from the helium-cesium mixture experiments in the same temperature range. They are

$\mu(Cs^+ \text{ in He}) = 18.5 \pm 0.5$ cm^2/v-sec, and

$\mu(Cs^+ \text{ in Cs}) = 0.4 \pm 0.05$ cm^2/v-sec referred to standard gas density (i.e., 2.69×10^{19}/cm^3). (Contractor's abstract)

1207

Illinois U. Coordinated Science Lab., Urbana.

DISTRIBUTION RC NETWORKS WITH RATIONAL TRANSFER FUNCTIONS, by K. W. Heizer. Sept. 1962, 83p. incl diagrs. tables, refs. (Rept. no. R-153) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 611008 Unclassified

A distributed RC circuit analogous to a continuously tapped transmission line can be made to have a rational short-circuit transfer admittance and rational short-circuit driving-point admittance. A subcircuit of the same structure has a rational open circuit transfer impedance and 1 rational open circuit driving-point impedance. Hence, rational transfer functions may be obtained while considering either generator impedance or load impedance. The functions have poles only along the negative real axis. Although the number of poles is arbitrary, only 2 may be chosen with complete freedom in a single unit. The residue of a pole in the short-circuit transfer admittance is related to the corresponding residue of the rational driving-point short-circuit admittance. A wide class of transfer functions may be realized by placing a distributed circuit in parallel with the output of another distributed circuit. The loss and total capacity required are often the same order of magnitude as those for lumped circuits. Complex zeroes may readily be obtained with these circuits. In many cases, active elements may be used to an advantage in the same manner as with lumped RC networks. (Contractor's abstract)

1208

Illinois U. Coordinated Science Lab., Urbana.

DUAL MODE OF COMPENSATION FOR A CLASS OF RANDOM PROCESSES, by D. P. Snyder. Feb 1, 1962, 51p. incl. diagrs. tables. (Rept. no. R-133) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 271715 Unclassified

In recent years there has been a marked interest in the analysis and design of various types of control systems. In particular, there has been a growing interest in those systems which are characterized by randomly varying parameters. It is assumed that the randomness of the system may be adequately described by a 2-level quantization. A 2-level quantization

means that the system alternates between 2 known configurations at random times. The philosophy and technique developed by Shaw are employed to deal with a problem of compensation for a system whose randomness is describable by a 2-level quantization. (Contractor's abstract)

1209

Illinois U. Coordinated Science Lab., Urbana.

ELECTRICAL BREAKDOWN IN HIGH VACUUM, by D. Alpert and D. Lee. June 7, 1962, 27p. incl. illus. diagrs. refs. (Rept. no. R-129) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 278564 Unclassified

The phenomenon of charge transfer which occurs when a potential difference is applied between electrodes in a high vacuum is discussed. The nature of prebreakdown currents and material transfer is related to the initiation of an arc between the electrodes. Gap spacings and vacuum conditions are considered. Some recent results for small gap spacings in ultrahigh vacuum are described, and a self-consistent picture proposed for the phenomena is observed. (Contractor's abstract)

1210

Illinois U. Coordinated Science Lab., Urbana.

ENERGY DISTRIBUTION OF ELECTRONS EJECTED FROM TUNGSTEN BY He^+, by F. M. Propst. July 1962, 19p. incl. diagrs. refs. (Rept. no. R-147) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 283015 Unclassified

Also published in Phys. Rev., v. 129: 7-11, Jan. 1, 1963.

The results of a calculation of the energy distribution of electrons ejected from tungsten by low energy He^+ are presented. The calculation is based on a mechanistic model of the process in which the ejected electrons are divided into 2 groups: (1) the electrons excited in the primary process that can escape directly; and (2) the electrons that escape because of interactions between the primary electrons and those of the band structure of the solid. Secondary electron data are used to predict the portion resulting from this second mechanism.

1211

Illinois U. Coordinated Science Lab., Urbana.

EXPERIMENTAL TEST OF THE CLUMP HYPOTHESIS OF VACUUM BREAKDOWN FOR LOW VOLTAGES, by M. Raether. July 1962, 5p. incl. diagr. refs. (Rept. no. R-148) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 263287 Unclassified

It has been suggested that electrical breakdown in high vacuum between metal electrodes is caused by clumps of loosely adherent material on the surfaces. In order to test this, an experiment was designed which intended to demonstrate clump induced breakdown in a realistic situation. Although no positive conclusions can be drawn from this experiment concerning the mechanism of vacuum breakdown, it is believed that the failure to verify the clump hypothesis indicates that for small gaps (for which breakdown voltage is proportioned to the field strength) the explanation for vacuum breakdown under ultra-high vacuum conditions should be sought in field emission phenomena.

1212

Illinois U. Coordinated Science Lab., Urbana.

HIGH INTENSITY CESIUM LAMP FOR OPTICAL PUMPING, by F. A. Franz. [1962] [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-85122) Unclassified

Published in Rev. Scient. Instr., v. 34: 589-590, May 1963.

The lamp consists of a 10 ml pyrex bulb containing a few mg of pure cesium and xenon gas at 1.5 m Hg pressure. The 25 mc/s Hartley oscillator used for excitation is described. The performance of the lamp was compared with that of 2 commercially available lamps in respect of the total radiant power, the power in the D lines of the emission spectrum, the optical pumping signal (measured in a transmission monitoring optical pumping apparatus) and the source areas. The results show that the new lamp is particularly suited to optical pumping applications.

1213

Illinois U. [Coordinated Science Lab.] Urbana.

HYPERFINE STRUCTURE OF ATOMIC NITROGEN, by W. W. Holloway, Jr., E. Lüscher, and R. Novick. [1962] [7]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-85122] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 126: 2109-2115, June 15, 1962.

The hyperfine structure of the ground state of N^{14} and N^{15} has been determined by optical pumping with spin exchange. A circulation system which forced the nitrogen through an electrodeless rf discharge into the resonance bulb, provided a continuous source of atomic nitrogen. Optically-pumped cesium was used to polarize and analyze the nitrogen. The zero-field intervals extrapolated to zero pressure are

N^{14}, $\nu(\frac{5}{2}-\frac{3}{2})$ = 26 127 288±40cps; N^{14}, $\nu(\frac{3}{2}-\frac{1}{2})$= 15 676 390 ±40 cps; and N^{15}, $\nu(2-1)$ = 29 290 902 ± 40 cps. The hyperfine constants are A^{14} = (+) 10 450 925 ± 20 cps, B^{14} = (-) 7 ± 20 cps, and A^{15} = (-) 14 645 441 ± 20 cps. These results include small corrections for second-order hyperfine interactions. A pressure shift of +1.9 ± 0.4 cps/mm Hg of N_2 was established for the N^{14} magnetic dipole interaction constant (A^{14}). The hyperfine structure anomaly is $\Delta = (A^{14} g_I^{15}/A^{15} g_I^{14}) - 1 = +(1.002 \pm 0.004) \times 10^{-3}$. The effect of spin-orbit and spin-spin mixing of the ^4S, ^2D, and ^2P states is discussed. (Contractor's abstract, modified)

1214

Illinois U. Coordinated Science Lab., Urbana.

THE IDENTIFICATION OF LINEAR SYSTEM WITH AN ASSESSMENT COMPUTER, by M. E. Suhre, Jr. May 1, 1962, 43p. incl. diagrs. refs. (Rept. no. R-139) (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 is applied to process identification for adaptive control. The method uses a special test signal and a corresponding estimating filter. The noise present at the output of the estimating filter is reduced by an assessment computer. The assessment computer does no processing until the entire estimate is available. Thus it is able to interpolate to estimate the noise. The effectiveness of the assessment computer is analyzed using knowledge of the statistics of the noise. Finally, the optimum test signal spectrum is obtained by minimizing the expected mean square error for a specified assessment policy.

1215

Illinois U. Coordinated Science Lab., Urbana.

A NUMERICAL APPROXIMATION TECHNIQUE FOR FILTER FUNCTIONS, by W. F. McGee. Aug. 1962, 62p. incl. diagrs. tables, refs. (Rept. no. R-151) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 611009 Unclassified

A new method is proposed for generating amplitude-frequency filter transfer functions of the usual type. The method consists of 2 algorithms based on modifications of the second method of Remez. Using this method, it is shown how to generate the following types of filter functions: (1) the low-pass equi-ripple polynomial filter function with zeros at the origin; (2) the low pass equi-ripple filter function with a variable number of zeros in the pass-band and a variable number of poles in the stop-band; (3) the asymmetrical equi-ripple band-pass filter function; and (4) the double band-pass equi-ripple filter function. The parameters that must be specified are discussed. Modifications to the basic methods that make them more useful to the filter designer are also presented. A discussion is given of the convergence of the proposed algorithms along with some examples. It is expected that these methods will be useful in filter design. (Contractor's abstract, modified)

1216

Illinois U. Coordinated Science Lab., Urbana.

ON PHYSICAL REALIZABILITY OF SIGNAL FLOW GRAPHS AND REALIZATION TECHNIQUES, by M. Lal. Dec. 1962 [51]p. incl. diagrs. (Rept. no. R-157) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under Da 36-039-sc-85122) AD 611098 Unclassified

The problem of physical realizability of the signal flow graphs is taken up and 2 classes of signal flow graphs are defined. It is shown that the class A encompasses all networks with independent sources, excluding mutual inductances. The realizability condition for this class is given and a realization technique established. Class B is shown to cover a very large class of active networks. The realizability condition and a realization technique for this class are given. The importance of these results for the network analysis and synthesis is discussed. Some aspects of the network synthesis problem are also considered and certain advantages of the synthesis through signal flow graph are pointed out. An attempt is made to establish an algorithm for deriving a member of class A or class B of signal flow graphs from the specified network function. Some difficulties in the way of achieving this are brought out. (Contractor's abstract)

1217

Illinois U. Coordinated Science Lab., Urbana.

A PATTERN RECOGNITION COMPUTER USING ALL-MAGNETIC LOGIC, by J. Divilbiss. Thesis, May 1962, 153p. incl. diagrs. tables, refs. (Rept. no. R-141) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 285694 Unclassified

The development of a pattern recognition computer consisting of a control computer and a pattern recognition unit (PRU) is described. The role of the PRU in the combined system is analogous to that of the arithmetic unit in a conventional digital computer. The 3 principal divisions of the PRU are (1) a dimensional shift register of N x N bits, (2) a k-word memory with N squared bits per word, and (3) a bubbler consisting of N squared bubble registers of length r. Each bubble register is a linear

'self-ordering' register, that is, a register in which a fixed number of identical operations will order the information with all ones at one end of the register, all zeros at the other end. The control computer is of conventional design and is not treated at length. Examples of simple pattern recognition routines are given. (Contractor's abstract)

1218

Illinois U. Coordinated Science Lab., Urbana.

A PHOTO-CURRENT SUPPRESSOR GAUGE FOR THE MEASUREMENT OF VERY LOW PRESSURES, by W. C. Schuemann. Oct. 1962 [12]p. incl. diagrs. tables. (Rept. no. R-156) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 611007 Unclassified

An ionization gauge has been designed which removes the low pressure limitation due to x-rays found in conventional ionization gauges while maintaining a comparable sensitivity. In this gauge, an additional electrode establishes an electric field which repels photo-electrons ejected from the ion collector. A similar photo-current from the suppressor grid is prevented by shielding this electrode from the x-rays. Preliminary experimental results have verified the suppression of photo-currents; pressures as low as 2×10^{-12} Torr have been measured. (Contractor's abstract)

1219

Illinois U. Coordinated Science Lab., Urbana.

REALIZABILITY CONDITIONS OF SINGLE-CONTACT NETWORKS, by S.-P. Chan. Dec. 1962, 72p. incl. diagrs. tables, refs. (Rept. no. R-158) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA DA 36-039-sc-85122) AD 293103 Unclassified

A selected set of necessary realizability conditions are derived from which a testing method is developed, so that one can apply it to a given function either to detect its nonrealizability or to simplify it before known synthesis procedures are employed. This investigation also shows that there exist certain classes of functions. They can be detected by the testing methods developed, as shown by various examples. The non-tree matrices and the non-realizable matrices are investigated. Also the correlations between the non-tree matrices and the nonrealizable functions are given and are verified by examples which illustrate the reasons for their nonrealizability. (Contractor's abstract)

1220

Illinois U. Coordinated Science Lab., Urbana.

REALIZABILITY OF FUNDAMENTAL CUT-SET MATRICES OF ORIENTED GRAPHS, by W. Mayeda. July 1962, 13p. incl. diagrs. refs. (Rept. no. R-143) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 285178 Unclassified Unclassified

As topology (linear graph theory) was recognized to be a suitable tool to solve many problems in electrical networks, switching circuits, communication nets, etc., the necessary and sufficient conditions that a matrix be a fundamental cut-set (or circuit) matrix becomes one of the important problems in this field. If the problem is to find whether a given matrix is a fundamental cut-set matrix of a non-oriented graph, there are 4 methods of testing such a matrix at present. One of these methods is modified such that it can be tested whether a given matrix is a fundamental cut-set matrix of an oriented graph. (Contractor's abstract)

1221

Illinois U. Coordinated Science Lab., Urbana.

SOME USEFUL PROPERTIES OF COMPOSITION, by B. R. Myers. Mar. 1962, 35p. incl. diagrs. tables. (Rept. no. R-135) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) Unclassified

A matrix representation of compositions of the positive real integers leads to some useful lemmas and theorems on the properties of single and multiple compositions. Examples are given of the application of these properties in the analysis of sequencing problems. (Contractor's abstract)

1222

Illinois U. Coordinated Science Lab., Urbana.

STATISTICAL DESIGN OF LINEAR MULTIVARIABLE SAMPLED DATA FEEDBACK CONTROL SYSTEMS, by M. Sobral. Feb. 1, 1962, 31p. incl. diagrs. refs. (Rept. no. R-132) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122) Unclassified

A linear multivariable sampled data feedback control problem has been studied. The problem is to design physically realizable controllers for multivariable plants subject to disturbances, satisfying a prescribed degree of rejection of the disturbing signals and over-all performances indexes. The system inputs are stochastic in nature and are characterized by their auto-correlation functions. Both the degree of rejection of the disturbances and the over-all performance indexes are given as upper bounds for mean square values. The technique presented is valid for non-minimum-phase plants, i.e., plants for which det P(z) has zeros outside the unit circle in the z-plane (P(z)being the plant matrix). It is, however, restricted to stable plants.

1223

Illinois U. Coordinated Science Lab., Urbana.

SUMMARY OF THE DEVELOPMENT OF THE CSL FEASIBILITY TEST ELECTRIC VACUUM GYROSCOPE (Unclassified title), by D. Skaperdas and H. W. Knoebel. July 1962 [31]p. incl. illus. (Rept. no. R-144) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 331449 Confidential

The Coordinated Science Lab. (CSL) electric vacuum gyro development since 1957 is described including frequent references to other CSL technical and progress reports. The current CSL work using the Control Data Corporation 1604 digital computer for electric vacuum gyro data evaluation is described in detail. (Unclassified)

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Illinois U. Coordinated Science Lab., Urbana.

THE USE OF AN AUTOMATIC COMPUTER SYSTEM IN TEACHING, by P. G. Braunfeld and L. D. Fosdick. Sept. 1962, 36p. incl. illus. diagrs. tables. (Rept. no. R-160) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-85122) AD 611097 Unclassified

Published in I. R. E. Trans. on Education, v. E-5: 156-167, Sept. 1962.

PLATO II is an automatic teaching device designed to teach a number of students concurrently, but independently, by means of a single, central, high-speed computer. Only 2 student sites have been constructed thus far, but, in principal, the number of students that can be taught by PLATO II is limited only by the capacity and speed of the central computer. The power of such a computer-based teaching system stems from its ability to ask complex questions, judge the students' answers to these questions, and take an appropriate course of action on the basis of student responses. The computer also keeps detailed and accurate records of student performance, which are extremely useful guides to improving course content. The paper reports in some detail a study using PLATO II to teach 9 undergraduate students a portion of a course on computer programming. Some analysis and interpretation of data gathered by the computer during the study are represented. The apparent effectiveness of PLATO II as a teacher, as well as the kinds of problems encountered in preparing lesson material for an automatic system, is discussed. (Contractor's abstract)

1225

Illinois U. [Dept. of Chemistry and Chemical Engineering] Urbana.

INFRARED AND NUCLEAR MAGNETIC RESONANCE SPECTRA OF METHYLTIN COMPOUNDS, by T. L. Brown and G. L. Morgan. [1962] [5]p. incl. diagrs. tables, refs. (AFOSR-J1094) (AF 49(638)-166) AD 420679 Unclassified

Also published in Inorg. Chem., v. 2: 736-740, Aug. 1963.

The infrared and nmr spectra of a number of methyltin compounds containing tin-tin bonds have been studied. Polydimethyltin, $[Sn(CH_3)_2]_x$, prepared from the reaction of dimethyltin dichloride and sodium in liquid ammonia, consists of linear chains containing from 12 to 20 catenated tin atoms. A second form of polydimethyltin has been characterized as possessing a cyclic, six-membered ring of tin atoms (dodecamethylcyclohexatin). Observation of the ^{117}Sn and ^{119}Sn-proton couplings reveals that increasing catentation results in a decrease in J_{Sn-CH_3} and an increase in $J_{Sn-Sn-CH_3}$. An empirical relationship between J_{Sn-CH_3} and both the symmetric and asymmetric tin-carbon stretching modes for a series of methyltin compounds is proposed, employing data taken from the literature. The infrared and nmr data for hexamethylditin and linear polydimethyltin fit the empirical relationship. (Contractor's abstract)

1226

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

HABIT PLANES OR MARTENSITE IN CHROME-CARBON STEEL, by H. M. Otte and T. A. Read. [1957] [6]p. incl. illus. diagrs. table, refs. (AFOSR-3624) (AF 18(600)1311) Unclassified

Also published in Jour. Metals, v. 9: 412-417, Apr. 1957.

For abstract see item no. ILL. 07:005, Vol. II.

1227

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

ANALYSIS OF DIFFUSION IN MEDIA UNDERGOING DEFORMATION, by H. Fara and R. W. Balluffi. Dec. 1957, 4p. (AFOSR-3367) (AF 18(603)-106) Unclassified

Also published in Jour. Appl. Phys., v. 29: 1133-1134, July 1958.

For abstract see item no. ILL. 19:006, Vol. II.

1228

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

MARTENSITE IN ZONE-REFINED IRON, by C. M. Wayman and C. J. Altesetter. [1962] [2]p. incl. illus. (AFOSR-4002) (AF 49(638)420) Unclassified

Also published in Acta. Metall., v. 10: 992-993, Oct. 1962.

Foil samples 3" x 1 4" x 0.008" of zone-refined electrolytic iron were heated in a dried He atmosphere, and quenched in Hg at 80°F. There is much evidence to show that martensite was formed, including micrographs showing martensitic structures with cracks.

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Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

THE CRYSTALLOGRAPHY OF THE AUSTENITE-MARTENSITE TRANSFORMATION IN AN Fe-Cr-C ALLOY, by K. A. Johnson and C. M. Wayman. [1962] [6]p. incl. diagrs. table, refs. (AFOSR-J743) (AF 49(638)420) AD 413641 Unclassified

Also published in Acta. Cryst., v. 16: 480-485, June 10, 1963.

An analysis of the crystallography of the austenite-martensite transformation in a high purity Fe-Cr-C alloy was made. Lattice parameters of the 2 phases, the austenite-martensite orientation relationship and the habit plane of the martensite were determined experimentally. Considerably less scatter in habit plane poles was observed than has been reported by others for a similar alloy. None of the existing crystallographic theories adequately explains the results, and it is suggested that an additional anisotropic interface distortion be incorporated into the theory. An inverse method of analysis for determining the pattern of inhomogeneity is discussed, with particular reference to the orientation relationship, and it is shown that the orientation relationship is a comparatively inaccurate quantity when used in theoretical calculations. (Contractor's abstract)

1230

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

METAL-GAS EQUILIBRIUM AND THE NIOBIUM-NITROGEN SOLID SOLUTION, by J. R. Cost and C. Wert. Jan. 15, 1962 [46]p. incl. diagrs. tables, refs. (AFOSR-2067) (AF 49(638)672) AD 273232 Unclassified

A method is developed for displaying in a 3-dimensional plot the pressure-temperature-composition equilibrium for a metal-gas system. The coordinates used are log P, 1/T, and log x. In this coordinate system, several simplications result over the ordinary P-T-x plot. A series of measurements on Nb-N equilibrium were made to see how well this real metal-gas system obeys the ideal system. The Nb-N binary obeyed the rules for ideal behavior very well. The major features of the binary may be described by a small number of thermodynamic parameters. (Contractor's abstract)

1231

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

EMISSIVITIES OF NIOBIUM (COLUMBIUM) AND NIOBIUM-NITROGEN SOLIDS SOLUTIONS, by J. R. Cost. [1962] [2]p. incl. tables. (AFOSR-4251) (AF 49(638)672) Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 634-635, June 1962.

Measurements were made on the outer surface of the specimen of the apparent specimen temperature, S, and on the inner blackbody surface of the true specimen temperature, T. The spectral emissivity, ϵ_λ, for 0.65 u radiation was then obtained from the relation $(1/T) - (1/S) = (\lambda/C_2) \ln \epsilon_\lambda$, where $C_2 = 1.438$ cm °K is the second radiation constant. The total emissivity, ϵ_t, was obtained from the Stefan-Boltzman total radiation law, $\epsilon_t = (P/\sigma T^4 A)$. In this expression $\sigma = 5.67 \times 10^{-12}$ watts cm^{-2}, A is the surface area of the specimen, and P is the power. It is observed that the spectral emissivity shows very little variation with temperature. The average ϵ_λ value is 0.345 with a standard deviation for the measurement of 0.0075. The total emissivity is found to increase with temperature.

1232

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

DIFFUSION OF CLUSTERS OF NITROGEN ATOMS IN IRON (Abstract), by D. Keefer and C. Wert. [1962] [1]p. [AF 49(638)672] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 234, Mar. 26, 1962.

Association of interstitial nitrogen in iron has been examined by determining the anelastic spectrum of the solid solution. Four distinct relaxations were observed. One of these is that of single nitrogen atoms, the Snoek effect. Diffusion coefficients calculated from this effect agree well with values reported in the literature. A second relaxation is thought to be associated with pairs of N atoms. These pairs diffuse about 10 times more slowly than do singles at the same temperature. A third relaxation is thought to be a cluster-of-three, a tri-interstitial. They diffuse about 10 times more slowly than do pairs at the same temperature. A fourth relaxation is so far unidentified with a particular

model. The atoms in this configuration move through the lattice with relaxation time only a little slower than the singles do. Binding energies of the clusters of two and of three can be estimated. They are about 0.1 and 0.35 ev, respectively.

1233

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

DISLOCATIONS IN SOLIDS, by R. Thomson. Final rept. Dec. 24, 1962, 6p. incl. refs. (AFOSR-4473) (AF 49(638)819) AD 295350 Unclassified

The object of this work was to study the dynamic aspects of the discreteness of dislocation cores. The 4 major efforts which have been completed are: (1) theoretical studies of discrete dislocation models, (2) the theory of climb, (3) pipe diffusion in LiF, (4) dislocation mobility in Ge.

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Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

PIPE DIFFUSION IN LiF, by R. Tucker, A. Lasker, and R. Thomson. [1962] [4]p. incl. diagrs. (AFOSR-J760) (AF 49(638)819) AD 414079 Unclassified

Presented at Internatl. Cong. on Crystal Lattice Defects, Kyoto (Japan), Sept 7-12, 1962.

Also published in Jour. Appl. Phys., v. 34: 445-452, Mar. 1963.

Also published in Jour. Phys. Soc. Japan, v. 18, Suppl. III: 120-123, Mar. 1963.

Impurity diffusion of Na ions along dislocations in LiF has been studied by both DC and transient techniques. The Na impurity is injected into the LiF by plating NaCl on 1 surface of the LiF and placing a potential across the crystal at an elevated temperature. Large scale diffusion with Na dendrite formation is observable in a dc arrangement and the diffusion can be measured by either radioactive tracer methods or measurement of charge transport. Transient experiments yield an activation energy for diffusion of approximately 0.3 ev for both edge and screw dislocations, and $D_0 = 0.01$ cm^2/sec. Analysis of the charge effects in the core of the dislocations leads one to propose a very large vacancy density in the core, and the experiments are even best understood in terms of a hollow of atomic dimensions along the dislocation core. (Contractor's abstract)

1235

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

DISLOCATION MOBILITY IN GERMANIUM (Abstract), by M. Kabler. [1962] [1]p. [AF 49(638)819] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 65, Jan. 27, 1962.

The motion of dislocations in pure germanium crystals has been investigated via etch pit techniques similar to those utilized by Johnston and Gilman on LiF. Stresses were applied by simple bending, and care was taken to avoid possible effects from chemical contamination. Within the experimentally accessible velocity range from 10^{-7} to 10^{-2} cm/sec, an empirical dependence of dislocation velocity on stress and temperature has been obtained. At 730°K, the velocity of screw and 60-deg dislocations is the same under 8 kg/mm^2 shear stress; however, under 0.5 kg/mm^2, screw dislocations move distinctly faster than 60-deg dislocations. At this lower stress, screws moving in a certain direction often cross-glide, while screws moving in the opposite direction do not. Under high stress, a screw which has previously cross-glided at low stress is observed to return rapidly to its original glide plane, along which it proceeds at its normal glide velocity. Possible explanations for this and related behavior will be discussed.

1236

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

DISLOCATION MOBILITY IN GERMANIUM (Abstract), by M. Kabler, V. Celli, and R. Thomson. [1962] [1]p. [AF 49(638)819] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 211, Mar. 26, 1962.

By means of an etch-pit technique, the temperature and stress dependence of the velocity of individual screw and 60-deg dislocations in pure germanium has been measured directly. On a log-velocity-vs-reciprocal-stress plot (over three decades in stress), the data depart somewhat from a straight line, being slightly concave upward. At constant stress, the velocity varies with temperature in a way indicating a thermally activated process with activation energies around 1.5 ev. Moving dislocations tend strongly to straighten out in [110] directions. This is taken as evidence that the Peierls force has an important influence upon the motion. On this basis, various modifications of simple-kink theory and their relevance to the present data are discussed.

1237

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

ELECTRONIC STATES ON SCREW DISLOCATIONS (Abstract), by A. Gold, V. Celli, and R. Thomson. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)819] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 65, Jan. 24, 1962.

Bound states for an electron in a many valley semiconductor arising from the strain field of a screw dislocation have been investigated within the framework of elastic continuum, effective mass, and deformation potential theories. If the valence band is centered at k = 0 there will be no spatially coincident trapping state for holes. Upper and lower limits for the lowest state of an electron bound to a screw dislocation in Ge have been calculated. These closely bracket the acceptor level which is observed to lie about 0.2 ev below the conduction band in deformed crystals. The results indicate that the customary "dangling bond" model need not be invoked in the description of dislocation states and that they may be envisioned as arising from the strain field alone. The cases of edge and 60° dislocations are also discussed.

1238

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

DIFFUSION RATES IN FACE-CENTERED CUBIC COPPER- ZINC ALLOYS DURING TORSIONAL DEFORMATION, by D. H. Killpatrick and R. W. Balluffi. [1962] [8]p. incl. diagrs. tables, refs [AF 49(638)880] Unclassified

Published in Acta Metall., v. 11: 439-446, May, 1963.

Chemical diffusion rates were obtained in a 13 at-% zinc-87 at % copper alloy as a function of torsional strain rate by measuring the rate of loss of the highly volatile zinc during vacuum heating. High purity, randomly oriented single crystals were strained at constant rates in the range 809-549°C under vacua < 10^{-5} torr. Strain rates in the range 1.4 x 10^{-5} sec^{-1} to 598 x 10^{-5} sec^{-1}, and strains up to 16.1 were employed. At the higher temperatures mean diffusion penetrations of the order of the order of 10-100 μ were achieved, while at the lower temperatures the penetrations were of the order of 1-20μ. Changes in specimen structure were observed by x-ray and metallographic methods. Diffusion anneals at zero strain rate were carried out in order to test the validity of the experimental technique. It was found that: (1) the weight loss technique employed was sufficiently reliable for the purposes at hand; (2) in no case was any detectable enhancement of true bulk diffusion found as a result of the deformation; (3) at sufficiently large strains recrystallization occurred leading to large amounts of in intercrystalline cracking. The cracking led to apparent enhanced diffusion according to the weight loss technique used because of rapid short-circuiting loss of the volatile zinc along the cracks. (Contractor's abstract)

1239

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

ON STRAIN-ENHANCED DIFFUSION IN METALS. I. POINT DEFECT MODELS, by R. W. Balluffi and A. L. Ruoff. [1962] [14]p. incl. refs. [AF 49(638)880] Unclassified

Published in Jour. Appl. Phys., v. 34: 1634-1647, June 1963.

Plastic deformation may affect bulk diffusion by altering the rates of point defect production and annihilation. A detailed analysis of this phenomenon is given with particular emphasis upon possible upper limits for the magnitude of the effect at elevated diffusion temperatures where bulk diffusion occurs over macroscopic distances. In order to consider all possibilities from this point of view the following 3 models are analyzed: (I) vacancies may be created or destroyed at jogs on gliding screw dislocations and climbing edge dislocations. These possible vacancy sources and sinks are intermixed within crystal subgrains and the net source or sink action is zero over representative subgrain volumes; (II) a net vacancy source (or sink) action is required within the subgrains in order to support the required nonconservative dislocation motion. The required excess vacancies are destroyed (created) at the subgrain boundaries where the concentration is maintained in equilibrium; and (III) large numbers of vacancies are readily created everywhere during deformation but are destroyed everywhere in the specimen volume only with difficulty. It is concluded that model I is probably the most realistic. In addition to the analysis of the above 3 models, detailed discussion is given of the following aspects of the diffusion-deformation problem: (1) effect of surface vacancy sinks on diffusion-deformation experiments carried out near a free surface; (2) diffusion enhancement expressed in terms of the number of excess vacancy jumps; (3) temperature dependence of the diffusional effects of deformation; (4) mechanical work required to maintain nonequilibrium vacancy concentrations; (5) the relationship between macroscopic creep behavior and nonequilibrium vacancies: (6) the possibilities of interstitial production. (Contractor's abstract, modified)

1240

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

ON THE MAGNITUDE OF VACANCY SUPERSATURATIONS IN SILVER DURING DEFORMATION AT ELEVATED TEMPERATURES, by R. B. Minch and R. W. Balluffi. [1962] [9]p. incl. diagrs. tables, refs. [AF 49(638)880] Unclassified

Published in Jour. Phys. and Chem. Solids v. 24: 443-451, Mar. 1963.

The electrical resistivity of large silver single crystals was measured during and directly after plastic deformation under essentially isothermal conditions near 700 and 800°C. Strain rates of 11.6 x 10^{-5} and 58.3 x 10^{-5} sec^{-1}, and total strains between 0.07 nad 0.09 were employed. Particular efforts were made to detect transient resistivity decays directly after the cessation

of deformation such as would be produced by the possible decay of deformation-induced crystal defects. In 2 runs no resistivity decay greater than the experimental sensitivity of about 2.6×10^{-10} Ωcm was found. In 3 runs extremely small apparent decays of the order of 10^{-9} Ω cm were found. These small effects could conceivably have been due, in whole or part, to: (1) experimental factors not related to the actual relaxation of defects in the specimens; (2) decay of excess dislocations; and (3) decay of excess point defects. Possibility (1) could not be confirmed or rejected by any independent means. Possibility (2) was practically eliminated by approximate calculations which indicated that the resistivity due to the excess dislocations was well below the level of detection. Possibility (3) was shown to correspond to vacancy supersaturations in the specimens during deformation no larger than those in the range between 6 and 90%. The experimental results are therefore completely consistent with the diffusion-deformation measurements of Savitskii and Darby et al which predict vacancy supersaturations less than ~ 50% during similar deformation in silver but are in marked disagreement with the diffusion-deformation experiments of Forestieri and Girifalco and Lee and Maddin which imply supersaturations at least 2 orders-of-magnitude larger.

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Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

RESEARCH ON DIFFUSION AND IMPERFECTIONS IN METALS, by R. W. Balluffi. Final rept. Sept. 1962, 16p. incl. refs. (AF 49(638)880)
Unclassified

The research has concentrated mainly on several aspects of chemical and self-diffusion and other kinetic processes involving crystal defects. Specific investigations include: (1) self-diffusion in Ag during plastic deformation in torsion; (2) relative polygonization rates in Cu and Cu-Zn alloys; (3) kinetic theory of dislocation climb; (4) theory of strain-enhanced diffusion in metals; (5) diffusion rates in fcc Cu-Zn alloys during torsional deformation; and (6) the magnitude of vacancy supersaturations in Ag during deformation at elevated temperatures. (Contractor's abstract)

1242

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

STRAIN-ENHANCED DIFFUSION IN METALS. II. DISLOCATION AND GRAIN-BOUNDARY SHORT-CIRCUITING MODELS, by A. L. Ruoff and R. W. Balluffi. [1962] [6]p. incl. diagr. refs. (Sponsored jointly by Advanced Research Projects Agency, Air Force Office of Scientific Research under [AF 49(638)880], Atomic Energy Commission, and National Science Foundation) Unclassified

Published in Jour. Appl. Phys., v. 34: 1848-1853 July 1963.

Rapid diffusion along dislocation cores generally enhances the average bulk diffusion in a dislocated crystal. If each diffusing atom has at least several opportunities to make rapid excursions along various dislocation cores, Hart has shown that $D_T/D_T^0 = 1 + f D_p/D_T^0$. D_T is the average bulk diffusivity, D_T^0 is the diffusivity in the dislocation-free lattice, f is the fraction of atoms in dislocation pipes, and D_p is the diffusivity along dislocation pipes. Under these conditions, the diffusion-penetration is increased by the short-circuiting but the general shape of the penetration curve is unaffected. When the dislocations are static, each diffusing atom must visit a number of dislocations, and a necessary condition for the Hart relation to hold is $2(D_T^0 t)^{1/2} > l_d$, where t is the diffusion time, and l_d is the dislocation spacing. When this condition fails (for example, at lower temperatures), and when the dislocations are static, it is demonstrated that the amount of short-circuiting is greatly reduced and that the dislocations become essentially "clogged." A parallel development is given for short-circuiting due to grain boundaries. In particular, it is shown that grain boundary migration and recrystallization, which occurs repeatedly during deformation of metals with low stacking fault energy, can, for temperatures equal to or less than about half the melting temperature, lead to a greatly increased diffusion coefficient without altering the general shape of the penetration curve.

1243

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

MOBILITY OF DISLOCATIONS IN GERMANIUM, by V. Celli, M. Kabler and others. [1962] [4]p. incl. diagrs. (AFOSR-J580) (AF AFOSR-62-179) AD 415209 Unclassified

Presented at Internat'l. Conf. on Crystal Lattice Defects, Tokyo (Japan), Sept. 3-4, 1962.

Also published in Jour. Phys. Soc. Japan, v. 18, Suppl. I: 20-23, Mar. 1963.

Experimental curves obtained by Kabler can be best plotted as $v = v_0 \exp(-E/kT - \tau_0/\tau)$. In order to explain this law, it is supposed that kinks are nucleated on segments of the line between pinning points. At the pinning points, the kinks are momentarily stopped until a fluctuation of sufficient size is available. If the segment is short or the stress low, the activation barrier for kink collapse is less than the barrier for forward motion beyond the pinning point, and the segment cannot supply successful kinks to the line. If the segment is sufficiently long, successful kinks can be created. Two ranges of velocity are obtained; the first valid in the kink collision range and the second when the ends of the dislocation represent the kink sinks. (Contractor's abstract)

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Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

THE CLUSTERING OF N IN B. C. C. IRON, by D. Keefer and C. Wert. [1962] [9]p. incl. diagrs. tables, refs. [AF AFOSR-62-192] Unclassified

Published in Acta Metall., v. 11: 489-497, June 1963.

The clustering of N in b.c.c. Fe has been studied using the anelastic behavior of the solid solution. The data are interpreted as showing that N exists near room temperature as dispersed single atoms, in pairs and in triplets. The mobility of these clusters is lower than that for singles at a given temperature. The clusters exist in more than random numbers; work must be done to separate them into single isolated atoms in the lattice. Their work is estimated to be 1500 cal/mol for pairs and 5000 cal/mol for triplets. (Contractor's abstract)

1245

Illinois U. Dept. of Physics, Urbana.

SURFACE STUDIES BY RADIOACTIVE METHODS, by H. Frauenfelder. Final rept. Mar. 1962 [14]p. incl. diagrs. refs. (AFOSR-2377) (AF 18(603)49) AD 411814 Unclassified

The basic aim of the work performed under this contract can be summarized as a study of surface properties in ultrahigh vacuum with radioisotopes. At certain times interest was switched onto new fields. Superconducting properties, for example, were studied and the discovery of the Mössbauer effect added a new dimension to possible experiments. Topics covered include: the magnetic field in superconductors; nuclear resonance absorption and nuclear Zeeman effect in Fe^{57}; search for the anisotropy of inertia; radiotracer studies of adsorption and desorption at clean solid surfaces; desorption measurements with Sb^{124} and In^{111}; angular correlation Cd^{111} on surfaces; and recoil studies with Cd^{107}, Ga^{67}, and Zn^{62}.

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Illinois U. Dept. of Physics, Urbana.

THE MÖSSBAUER EFFECT, by H. Lustig. [1960] [18]p. incl. diagrs. refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)49], Atomic Energy Commission, and Office of Naval Research) Unclassified

Published in Amer. Jour. Phys., v. 29: 1-18, Jan. 1961.

Recent discovery and several important applications of recoilless gamma-ray fluorescence are reviewed. Its main purpose is to give to nonspecialists a self-contained introduction to this currently very lively field of research. The importance of the fluorescence technique and its limitations, before Mössbauer's discovery, are discussed. Mössbauer's pioneering gamma-ray emission is presented. From among the large number of recent experiments which make use of the Mössbauer effect, two groups are selected for discussion. The first is concerned with the discovery of nuclear and magnetic properties of Fe^{57}; the other with a test of the principle of equivalence in general relativity, by a measurement of the gravitational shift in the frequency of radiation.

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Illinois U. [Dept. of Physics] Urbana.

PRESSURE SHIFT OF THE HYPERFINE OF ATOMIC NITROGEN (Abstract), by W. W. Holloway, Jr., E. Lüscher, and R. Novick. [1962] [1]p. [AF 18 (603)49] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 26, Jan. 24, 1962.

The hyperfine structure of the ground state of N^{14} and N^{15} have been determined by optical pumping with spin exchange. A circulation system, which forced the nitrogen through an electrodeless rf discharge into the resonance bulb, provided a continuous source of atomic nitrogen. Optically pumped cesium was used to polarize and analyze the nitrogen. The zero field intervals extrapolated to zero pressure are $N^{14}\nu(\frac{5}{2}-\frac{3}{2}) = 26\,127\,325 \pm 45$ cps, $N^{14}\nu(\frac{2}{3}-\frac{1}{2}) = 15\,676\,394 \pm 40$ cps, and $N^{15}\nu(2\text{-}1) = 29\,290\,962 \pm 25$ cps. The hyperfine constants are $A^{14} = 10\,450\,930 \pm 20$ cps, $B^{14} = 0 \pm 17$ cps, and $A^{15} = 14\,645\,451 \pm 25$ cps. The results for N^{15} differ from the earlier values reported by Anderson et al. A pressure shift of $+1.8 \pm 0.4$ cps/mm Hg of N_2 was established for the N^{14} magnetic dipole hyperfine interaction constant (A^{14}). This result is consistent with the observations of Jen and co-workers on trapped N atoms.

1248

Illinois U. Dept. of Physics, Urbana.

ELEMENTARY EXCITATIONS IN LIQUID HELIUM, by A. Miller, D. Pines, and P. Nozières. [1962] [12]p. incl. diagrs. refs. (AFOSR-2582) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)528 and Army Research Office (Durham)) Unclassified

Also published in Phys. Rev., v. 127: 1452-1464, Sept. 1, 1962.

An analysis of some experimental and theoretical investigations of the elementary excitation spectrum of liquid He II is carried out. The spectrum density fluctuations is shown to consist of 2 parts: direct excitation of single quasi-particles from the condensed zero-momentum state; and excitation of more complex configurations arising from the interaction of 2, 3, or more quasi-particles. It is demonstrated that: (1) in the long-wavelength limit, a single quasi-particle excitation exhausts the f-sum rule; (2) this asymptotic behavior of the density fluctuatuation spectrum may be used to normalize the experimental results of Henshaw and Woods; one thereby obtains a somewhat altered liquid structure-factor curve, detailed information on the efficiency of quasi-particle excitation from the condensed state of an incident slow neutron, and an estimate of the depletion of the zero-momentum state as a consequence of particle interaction; (3) the backflow introduced by Feynman and Cohen corresponds to taking into account the coupling between a Feynman excitation and higher configurations involving several elementary excitations. It is shown that in the Bogoliubov approximation the backflow around the impurity atom corresponds to a cloud of moving virtual-phonon excitations which act to increase the impurity effective mass as well as to conserve current in the system. The generalization of these results to higher-order approximations, and to the coupling between quasi-particles in liquid helium, is discussed. The importance of accounting properly for depletion effects in a microscopic theory is emphasized. (Contractor's abstract, modified)

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Illinois U. Dept. of Physics, Urbana.

FORMATION OF HYDROXYL ION AND U CENTERS IN ADDITIVELY COLORED POTASSIUM BROMIDE CRYSTALS, by R. S. Crandall. [1962] [2]p. incl. diagr. (AFOSR-64-0752) (AF 49(638)529) AD 436518 Unclassified

Also published in Jour. Chem. Phys., v. 38: 1036-1037, Feb. 15, 1963.

Harshaw KBr crystals were additively colored and the absorption spectra of thin sections investigated. It was found that whereas OH^- centers were only formed near to the crystal surface, the U centers also occurred in the interior. It is proposed that the potassium formed on the surface during the thermal bleaching of the F-centers reacts with the water in the air forming potassium hydroxide and hydrogen. A fraction of these diffuse into the crystal, the hydroxyl ions substituting the halides and the hydrogen reacting with the F-centers to form U-centers.

1250

Illinois U. [Dept. of Physics] Urbana.

ZONE MELTING OF POTASSIUM CHLORIDE, by T. M. Srinivasan. Dec. 1962 [15]p. incl. diagrs. table. (Technical note no. 3) (AF 49(638)529) AD 294013 Unclassified

It is possible by straightforward, reproducible, and relatively simple zone refining procedures to produce potassium chloride crystals of a purity superior to that commercially available. The zone refining can be carried out in silica crucibles but should be performed in an atmosphere of chlorine gas to prevent adhesion of the salt to the crucible. Prior to zone refining, the salt should be baked in an atmosphere of chlorine gas. The purity obtained as a result of the zone refining operation depends upon the number of zones passed through the salt ingot but the impurity improves only slightly if more than ten passes are used. The results obtained are similar to those of Grundig but were achieved with a smaller number of zone passes. Potassium chloride that was zone refined in high purity graphite crucibles had graphite specks adhering on or near the surface. Also, it was difficult to cleave single crystals from the ingot for conductivity measurements. The purity of the crystals was of the same order of magnitude as that of the commercially available crystals.

1251

Illinois U. Dept. of Physics, Urbana.

RESEARCH ON THE ELECTRONIC PROPERTIES OF THE SILVER AND ALKALI HALIDES, by F. C. Brown. Final rept. Jan. 31, 1959-Jan. 31, 1962. Feb. 1962 [11]p. (AFOSR-2272) (AF 49(638)579) Unclassified

A summary of work completed while studying the electronic properties of suitably prepared silver and alkali halides by means of electrical and optical measurements at temperatures down to that of liquid helium is given. Also summarized is the understanding gained of such phenomena: (1) electron trapping, (2) the factors which affect the mobility of electrons and holes, and (3) scattering processes.

1252

Illinois U. Dept. of Physics, Urbana.

LIFETIMES OF EXCITED STATES IN ALKALI HALIDE CRYSTALS CONTAINING F-CENTERS, by R. K. Swank. June 1962, 163p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-3043) (AF 49(638)579) Unclassified

Measurements were made of the lifetimes of excited F-centers in KCl, NaCl, KBr, and KI crystals by observing the time dependence of the fluorescence and photoconductivity following excitation by a short pulse

of light. A special flash lamp was developed for use as the exciting source. It has a width at half max of 18 nsec and a useful output of 10^{13} photons in the range 2 to 6 ev. The behavior of the lifetime of the excited F-center as a function of temperature can be interpreted in terms of a simple model in which the only 2 modes of decay are by radiative transition to the ground state or thermally induced ionization. Using the model, the radiative lifetime of the excited F-center is found to be: KCl - 0.58 μsec, NaCl - 1.00 μsec, KBr - 1.11 μ sec, KI - 2.22 μ sec. The activation energy for thermal decomposition of the excited F-center in KCl is found to be 0.15 ev. The lifetime of the F-center fluoresence in KCl is independent of concentration below 2×10^{-16} F-centers/cm^3, but is 20% smaller at 3×10^{17} F-centers/cm^3. It is not influenced by the presence of M-centers unless the concentration of the latter is high, in which case the F-luminescence is almost completely quenched and is replaced by M-luminescence. The decay constant of the latter is 60 nsec.

1253

Illinois U. [Dept. of Physics] Urbana.

HALL MOBILITY OF HOLES IN SILVER BROMIDE, by R. C. Hanson. [1962] [5]p. incl. diagrs. table, refs. (AFOSR-J871) (AF 49(638)579) AD 415880 Unclassified

Also published in Jour. Phys. Chem., v. 66: 2376-2380, Dec. 1962.

Hall mobility measurements have been made on holes introduced into AgBr by a bromine atmosphere in the temperature range from room temperature to 150°. These measurements were made using conventional electrode geometry and sensitive high impedance ac techniques similar to those used by Macdonald and Robinson. The Hall mobility for holes varied from 2.0 ± 0.5 cm^2/v. sec at room temperature (27°) to 0.5 ± 0.15 cm^2/v. sec at 150°. The hole mobility is about 1/30 as large as 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. (Contractor's abstract)

1254

Illinois U. [Dept. of Physics] Urbana.

MOBILITY OF PHOTOELECTRONS IN THE SILVER HALIDES AT HIGH ELECTRIC FIELD (Abstract), by T. Masumi. [1962] [1]p. [AF 49(638)579] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 39, Jan. 24, 1962.

The mobility of electrons in AgCl and AgBr has been studied as a function of electric field or temperatures down to 4°K in an attempt to clarify the scattering mechanism of fast or hot electrons. High purity crystals prepared by zone refining in a halogen atmosphere were used to obtain high electron mobility, above 10,000 cm^2/volt sec at low temperature. A fast pulse technique was adopted to observe both the transient photoconductivity and the Hall mobility for photoelectrons. The results show that the mobility of fast electrons at low temperatures is a decreasing function of electric field. An energy dissipation mechanism similar to acoustic scattering is suggested for the fast electrons.

1255

Illinois U. Dept. of Physics, Urbana.

RESEARCH ON THE PHOTOPRODUCTION OF MESONS IN LIQUID HYDROGEN BUBBLE CHAMBER, by E. L. Goldwasser. Final rept. June 1, 1959-May 31, 1962, 5p. (AFOSR-3182) (AF 49(638)594) AD 283452 Unclassified

The prime purpose of this work has been to obtain some reliable data on the photoproduction of π mesons in the region near the threshold. The plan has been to operate the bubble chamber with hydrogen as a working liquid and to observe the production of positive π mesons by passing the x-ray beam through the liquid of the chamber. Measurements are to be made which will give information on the ranges and angles of production of the π mesons. Only those mesons which stop in the liquid of the chamber are to be used. In order that this information be more reliable than any that now exists, the projects for improving knowledge about the x-ray beam were undertaken. It is now believed that the uncertainties involved in x-ray beam flux and in its maximum energy are of the same order of magnitude as other uncertainties which are involved in the experiment. (Contractor's abstract)

1256

Illinois U. Dept. of Physics, Urbana.

NEGATIVE PION PROTON ELASTIC SCATTERING IN THE ENERGY RANGE 200 TO 1450 MEV, by L. Lavatelli. Final rept. June 1, 1959-May 31, 1962, 17p. incl. diagrs. table, refs. (AFOSR-3538) (AF 49(638)661) Unclassified

The results of a fairly systematic survey of the energy dependence of the differential elastic scattering of negative pions by protons for laboratory kinetic energies of the pions from 200 mev to 1450 mev are presented. The data for the 23 measurements that have been used in the survey in this energy region have been taken from

published articles, notes, and reports. The data have been consistently fitted with Legendre polynomials rather than powers of cos θ^*, where θ^* is the angle of the scattered pion in the center of mass system. No attempt has been made to give a theoretical interpretation of the results.

1257

Illinois U. Dept. of Physics, Urbana.

CALCULATION OF THE QUASIPARTICLE RECOMBINATION TIME IN A SUPERCONDUCTOR, by J. R. Schrieffer and D. N. Ginsberg. [1962] [2]p. (AFOSR-2311) (AF 49(638)882) Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 207-08, Mar. 1, 1962.

The recombination rate in a superconductor due to phonon emission is calculated using the following equation:

$$\Gamma_{\vec{k}} = \frac{2\pi}{\hbar} \sum_{\vec{k}', \lambda} |v(\vec{k}, \vec{k}'; \lambda)|^2 \times \frac{\hbar}{2v\vec{q}} |\mu(\vec{k}, \vec{k}')|^2_{\vec{q}, \lambda} f_{\vec{k}'} \delta(E_{\vec{k}} + E_{\vec{k}'} - \hbar\omega_{\vec{q}, \lambda}).$$

1258

Illinois U. Dept. of Physics, Urbana.

RESEARCH ON THE THEORY OF SUPERCONDUCTIVITY AND RELATED THEORETICAL PROBLEMS OF THE SOLID STATE, by J. R. Schrieffer. Final rept. Sept. 1, 1960-Aug. 31, 1962. Oct. 1, 1962, 12p. (AFOSR-3998) (AF 49(638)882) AD 290673 Unclassified

This report serves as a guide to publications and reports. There is a brief resume of the problems encountered such as: (1) lifetime effects in condensed fermion systems, (2) electromagnetic absorption by excitons in superconductors, and (3) calculation of the quasi-particle recombination time in a superconductor.

1259

Illinois U. Dept. of Physics, Urbana.

LIFETIME OF THE 26.8 KEV STATE OF I^{129}, by H. De Waard M. H. Garrell, and D. Hafemeister. [1962] [1]p. incl. diagr. (AFOSR-J14) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1048) and Office of Naval Research) AD 297149 Unclassified

Also published in Phys. Ltrs., v. 3: 59, Dec. 1, 1962.

In view of the properties reported for the ground state transition of the 26.8 kev level in I^{129} for Mössbauer experiments, the lifetime of this level was measured. The value $\tau = 26.8 \pm 1.5$ nsec was found for this lifetime from the delay distribution of the 26.8 kev γ-rays which follow excitation of the level by β-particles of maximum energy 1.45 mev emitted in the β-decay of Te^{129} (70 min). These results are compared with those of Moszkowski and Jha et al.

1260

Illinois U. Dept. of Physics, Urbana.

AUGER ELECTRON EJECTION FROM SUPERCONDUCTING METALS, by R. A. Craig. [1962] [4]p. (AFOSR-J287) (AF 49(638)1048) AD 435653) Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 257-260, Jan. 1, 1963.

The spectrum of Auger electrons emitted from a superconducting metal is compared with that of the normal metal within the Bardeen-Cooper-Schieffer model. Since pairing may be neglected outside the metal, the only differences would come from the change in densities of states. No difference in spectra is calculated. (Contractor's abstract)

1261

Illinois U. Dept. of Physics, Urbana.

LIFETIME OF THE 26.8 KEV STATE OF I^{129}, by H. De Waard, M. H. Garrell, and D. Hafemeister. [1962] [1]p. incl. diagr. (AFOSR-64-390) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1048 and Office of Naval Research) AD 434516 Unclassified

Also published in Phys. Ltrs., v. 3: 59, Dec. 1, 1962.

For abstract see item no. 1259 Vol. VI.

1262

Illinois U. Dept. of Physics, Urbana.

CYCLOTRON RESONANCE IN AgBr, by G. Ascarelli and F. C. Brown. July 1962, [12]p. incl. diagrs. table, refs. (Technical note no. 3) (AFOSR-3385) (AF AFOSR-62-215) AD 292909 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 209-211, Sept. 1, 1962.

Experiments were performed at 69.9 kmc/s so as to satisfy the condition $\omega\tau > \sim 1$ at low temperatures. At 27.2° K the line shape corresponds to $\omega_c\tau < 1$, and

the line has disappeared by 35°K. The resonance occurs at 6.6 kOe corresponding to a polaron mass $m^*/m_e = 0.27$, in good agreement with the recent theory of Feynman et al.

1263

Illinois U. Dept. of Physics, Urbana.

LIFETIME OF THE EXCITED F CENTER, by R. K. Swank and F. C. Brown. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-J867) (AF AFOSR-62-215) AD 415881 Unclassified

Also published in Phys. Rev., v. 130: 34-41, Apr. 1, 1963.

An investigation was carried out on the excited state of the F center in various alkali halide crystals as a function of temperature. Results are presented on the time dependence of photoconductivity and luminescence following excitation by a very short, 10^{-8} sec, pulse of light. The data can be interpreted in terms of a simple energy-level diagram of the F center consisting of a ground state and an excited state. Estimates are given of the depth of the excited state below the conduction band ΔE, the frequency factor for thermal ionization $1/\tau_0$, and the radiative lifetime τ_R, for KCl, KBr, KI, and NaCl. The radiative lifetime τ_R depends upon the alkali halide, but may be as long as 10^{-8} sec. Suggestions are made for understanding this long lifetime in view of the large oscillator strength of the F center. The effect of F-center concentration and also of an admixture of M centers is discussed.

1264

Illinois U. Dept. of Physics, Urbana.

ELECTRONIC PROPERTIES AND BAND STRUCTURE OF THE SILVER HALIDES, by F. C. Brown. [1962] [9]p. incl. diagrs. refs. (AFOSR-J868) (AF AFOSR-62-215) AD 415884 Unclassified

Presented at Symposium on Photographic Processes, Washington, D. C., Mar. 22-24, 1962.

Also published in Jour. Phys. Chem. v. 66: 2368-2376, Dec. 1962.

The band structure of AgCl and AgBr is discussed with emphasis on recent experiments which bear on the understanding of the solid state. These include external photo-emission, magneto-resistance at low temperature, and optical absorption. Certain additional phenomena are mentioned such as luminescence, electron-hole pair production by ionizing radiation, and the temperature dependance of electron mobility. The importance of high purity material produced by zone refining is pointed out. (Contractor's abstract)

1265

Illinois U. Dept. of Physics, Urbana.

MAGNETORESISTANCE OF SILVER BROMIDE, by H. H. Tippins and F. C. Brown. [1962] [9]p. incl. diagrs. table, refs. (AFOSR-J869) (AF AFOSR-62-215) AD 415885 Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 221, Mar. 26, 1962.

Also published in Phys. Rev., v. 129: 2554-2562, Mar. 15, 1963.

The magnetoresistance effect was investigated in high-purity zone-refined AgBr in order to obtain information about the conduction band structure in this material. The measurements were performed at 2°K and in magnetic fields up to 18 kG. The rate-of-drift method using a sensitive electrometer was employed to observe the transient photoconductivity both in the presence and absence of a magnetic field. Results of the experiments are consistent with the assumption of a spherically symmetric conduction band centered at $k = 0$ as well as with an electron relaxation time of the form: $\tau = \tau_0(\epsilon/KT)^{3/2}$, with $\tau_0 = 1.1 \times 10^{-12}$ sec.

During the course of the magnetoresistance measurements, a deviation from Ohm's law at high electric fields was noted. Some data on this "hot electron" effect are presented and briefly discussed.

1266

Illinois U. [Dept. of Physics] Urbana.

GEOMETRICAL SIGNIFICANCE OF ISALLO STRESS, by A. E. Scheidegger. [1962] [11]p. incl. diagrs. (AFOSR-4381) (AF AFOSR-62-419) AD 294813 Unclassified

Also published in New Zealand Jour. Geol. and Geophys., v. 6: 221-227, May 1963.

Isallo stress values can be ascertained from the fault patterns in certain areas. This report shows how the complete trajectories of the tectonic stresses can be obtained from isallo stress values. (Contractor's abstract)

1267

Illinois U. [Dept. of Psychology] Urbana.

PROPRIOCEPTION VARIABLES AS DETERMINERS OF ANTICIPATORY TIMING BEHAVIOR, by J. A. Adams and L. R. Creamer. [1962] [6]p. incl. diagr. refs. (AFOSR-1407) (AF 49(638)371) AD 451535 Unclassified

Also published in Human Factors, v. 4: 217-222, Aug. 1962.

Anticipatory timing, where the human operator initiates an accurate response before the actual occurrence of the environmental event, is one of the most striking and least studied aspects of skilled motor performance. An experiment was performed on temporal and control system variables that could influence the timing of responses in a tracking task. Verification was sought for a proprioceptive trace hypothesis that holds the time-varying proprioceptive after-effects of movements to be the internal trace that persists in time and cues the occurrence of a future response. Ninety-six subjects participated. A 2 x 2 x 2 randomized factorial design used 2 values each of movement amplitude, spring loading, and signal duration as a means of manipulating proprioceptive stimuli and their time trace. Results supported the hypothesis. Signal duration and spring loading of the control induced significant effects for the number of beneficial anticipations, but movement amplitude had no significant effect. It was concluded that proprioception has a role in response timing, in addition to its traditional one of informative feedback. (Contractor's abstract)

1268

Illinois U. [Dept. of Psychology] Urbana.

DATA PROCESSING CAPABILITIES OF THE HUMAN OPERATOR, by J. A. Adams and L. R. Creamer. [1962] [10]p. incl. diagrs. table, refs. (AFOSR-2859) (AF 49(638)371) AD 406865 Unclassified

Also published in Jour. Eng. Psychol., v. 1: 150-158, Oct. 1962.

An experiment was conducted on human data processing capabilities, and a test was made of the hypothesis that the human operator has a 1-channel decision center whose function is resolving event uncertainties. The bisensory discrete matching task was used, where discrete audio and visual stimuli were jointly presented for concurrent responses by the 2 hands. The visual stimulus series in the bisensory task always had event uncertainty to occupy the 1-channel central decision mechanism in accordance with the hypothesis, and concurrent audio stimuli were either partly or completely redundant. Comparison of performance under these 2 bisensory conditions was with a unisensory control condition that only practiced the visual stimulus series. There were 15 Ss in each of the 3 conditions. The results showed impairment for both bisensory conditions, and it was concluded, that the human operator can be considered a 1-channel system providing this channel is taken to be concerned with the resolution of event uncertainty. Automatization of responses to completely redundant stimuli was questioned.

1269

Illinois U. [Dept. of Psychology] Urbana.

EVENT UNCERTAINTY, PSYCHOLOGICAL REFRACTORY PERIOD, AND HUMAN DATA PROCESSING, by L. R. Creamer. [1962] [8]p. incl. diagrs. tables, refs. (AF 49(638)371) Unclassified

Published in Jour. Exper. Psychol., v. 66: 187-194, Aug. 1963.

An experiment was performed to (a) test the psychological refractory period (PRP) hypothesis of the human S as a 1-channel data processing system with an event uncertain-time certain stimulus series, and (b) determine the combined effect of time and event uncertainty. To test the PRP hypothesis, 5 groups of 12 Ss had 5 different time intervals between visual and audio stimuli (0, 100, 200, 400, and 800 msec). The visual S-R sequence produced a delay in audio responses that was significant at 0-, 100-, and 200-msec intervals. The human apparently responds as a 1-channel system when he processes event uncertain-time certain data. Another group of 12 Ss had the 5 interstimulus intervals with both time and event uncertainty. Their bisensory audio impairment was similar to the 5 time certain groups. (Contractor's abstract)

1270

Illinois U. Electrical Engineering Research Lab., Urbana.

THEORETICAL AND EXPERIMENTAL STUDY OF HIGH ENERGY BUNCHED ELECTRON BEAMS AND STUDIES IN QUANTUM AND SOLID STATE ELECTRONICS, by P. D. Coleman. Final rept. Mar. 1, 1956-Feb. 28, 1962, [36]p. incl. illus. diagrs. refs. (AFOSR-2580) (AF 18(603)62) AD 276042 Unclassified

The purpose of this work was to solve submillimeter wave problems and to study electron beams. Problem areas included: (1) high energy bunched electron beams, (2) frequency conversion in the low millimeter region by field emission, gas discharges, and ferrites, (3) tensor media resonators using ferrites, (4) coupling electron beams to Fabry-Perot resonators, (5) optical pumping, (6) optical frequency mixing, (7) and submillimeter masers (Contractor's abstract modified)

1271

Illinois U. Electrical Engineering Research Lab., Urbana.

APPLICATIONS OF LINEAR GRAPH THEORY TO PROBABILISTIC COMMUNICATION NETWORKS, by Y. Fu. Jan. 10, 1962 [58]p. incl. diagrs. refs. (Technical note no. 18) (AFOSR-1993) (AF 49(638)63) AD 271973 Unclassified

Probabilistic communication networks under study are assumed to consist of a finite number of stations and links, each having a specified value of reliability and capacity, and each statistically independent of all others.

The expected value of the terminal capacity between 2 specified terminals of the network is studied. A method for determining the expected value of terminal capacity as well as its upper and lower bounds is described. The influence due to variation of branch capacity and reliability on the expected value of terminal capacity is also investigated. Structures of networks composed of identical elements having maximum values of expected values of terminal capacity under different given conditions are described, and the structure of a network having maximum total expected values of terminal capacity with minimum reliability is given. (Contractor's abstract)

1272

Illinois U. Electrical Engineering Research Lab., Urbana.

TABLES OF THE TRANSVERSE MAGNETIC COEFFICIENTS K (γ) AND L (γ), by P. V. Gray. Apr. 30, 1962, 7p. incl. tables. (Technical note no. 6) (AFOSR-2665) (AF 49(638)417) AD 277073 Unclassified

Also published in Jour. Appl. Phys., v. 34: 291-293, Feb. 1963.

Tables of K (γ) and $L(\gamma)_2$ as defined by Willardson, Harman, and Beer are given over the range in which simple (high and low field) approximations are not valid. The tables permit easy multiband calculation of the transverse magnetoresistance and isothermal Hall coefficient in non-degenerate semiconductors in the lattice scattering range. (Contractor's abstract)

1273

Illinois U. Electrical Engineering Research Lab., Urbana.

ELECTRICAL AND OPTICAL PROPERTIES OF VITREOUS SELENIUM, by H. P. D. Lanyon. [1962] [10]p. incl. diagrs. table, refs. (AFOSR-64-2099) (AF 49(638)417) AD 451345 Unclassified

Also published in Phys. Rev., v. 130: 134-143, Apr. 1, 1963.

The space-charge limited current-voltage-characteristics of evaporated layers of vitreous selenium from 2.4 to 60 μ thick are described. It is shown that both an exponential and a Gaussian distribution of states will explain these characteristics. An analytic solution is derived for the case of the exponential distribution of states: $N(\epsilon) = N_0 e^{-\epsilon/\Delta}$, where N_0 is the density of states at the valence band edge which is taken to be the origin of energy. This solution, with $N_0 \sim 10^{20}/cm^3 ev$ and $\Delta = 0.067$ ev, will account for the characteristics of all the specimens independent of thickness. The model will also account for the results of the optical absorption, electron bombardment, quenching, and positive and negative photoresponse experiments of other workers. It is not possible to obtain an analytic solution for any of these cases for a Gaussian distribution of states: $N(E) = N_0 \exp\{-(E-E_{max})^2/\Delta^2\}$. However, it is shown that the distribution in energy of these states with $E_{max} = 2.35$ ev and $\Delta = 0.25$ ev fits the experimental results as well as does the exponential distribution. A Gaussian distribution of states would be expected theoretically in a disordered material such as vitreous selenium.

1274

Illinois U. [Electrical Engineering Research Lab.] Urbana.

OBSERVATION OF SURFACE AND IMPURITY STATES IN SILICON BY OXIDE LAYER TUNNELING, bu P. V. Gray. [1962] [4]p. incl. diagrs. (AFOSR 64-2100) (AF 49(638)417) AD 451346 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 302-305, Oct. 1, 1962.

Conductance and differential capacitances were measured as a function of frequency and bias for a number of silicon-silicon oxide-aluminum sandwiches; data are derived regarding the density and energy states near the silicon-silicon oxide interface. Conductance is due to electron tunneling transitions between aluminum and silicon. The density of interface states from low-frequency capacitance measurements is $\simeq 2 \times 10^{-12}$ states/ev cm^2. Impurity bands were detectable in heavily doped samples; lightly doped samples showed impurity bands due to boron.

1275

Illinois U. [Electrical Engineering Research Lab.] Urbana.

ELEMENTARY EXCITATIONS IN LIQUID HELIUM, by A. Miller, D. Pines and P. Nozières. [1962] [13]p. incl. diagrs. refs. [AF 49(638)417] Unclassified

Published in Phys. Rev., v. 127: 1452-1464, Sept. 1, 1962.

For abstract see item no. 1248, Vol. VI.

1276

Illino's U. [Electrical Engineering Research Lab.] Urbana.

SOME ELECTRICAL PROPERTIES OF AMORPHOUS SELENIUM (Abstract), by J. L. Hartke. [1962] [1]p. [AF 49(638)417] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 90, Jan. 24, 1962.

Hole and electron drift mobilities measured in pure amorphous selenium films agreed well with previous results (Proc. Phys. Soc. (London) B70: 669, 1957; B76: 826, 1950). Some evidence was obtained that the shallow electron and hole traps which are assumed to limit the drift mobilities were due to imperfections, a continuous distribution in energy of these levels being preferred. The addition of arsenic increased the concentration of imperfections which produce shallow electron traps, but the arsenic atoms themselves were apparently electrically inactive. Hole ranges were temperature independent, while electron ranges decreased with decreasing temperature measurements of space-charge-limited currents carried by holes were interpreted using a model of deep hole capture centers distributed uniformly in energy. The lowest observed value of electrical conductivity agreed well with values extrapolated from liquid selenium.

1277

Illinois U. [Electrical Engineering Research Lab.] Urbana.

PHOTOMULTIPLIER DETECTION OF MICROWAVE MODULATED LIGHT, by O. L. Grady and D. F. Holshouser. [1962] [4]p. incl. illus. (AFOSR-2306) (AF 49(638)556) AD 611355 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 50: 1525, June 1962.

A recent report (see item no. 1133; Vol. V) described the principles of dynamic crossed-field electron multiplication (DCFEM) and its use in the detection of light modulated at intermediate frequencies. This paper reports a subsequent experiment in which this method was used in a photomultiplier which directly detects light modulated at microwave frequencies. By driving the photomultiplier at a frequency f, which is close to the light modulation frequency f_s, the heterodyne detection is realized by observing the photomultiplier output current which is modulated at the difference frequency $f_d = |f - f_s|$.

1278

Illinois U. Electrical Engineering Research Lab., Urbana.

RESEARCH ON MODULATING LIGHT AT MICROWAVE FREQUENCIES, by D. F. Holshouser. Interim final rept. Feb. 1, 1959-Jan. 31, 1962, 13p. incl. diagrs. refs. (AFOSR-2474) (AF 49(638)556) AD 275342 Unclassified

The objectives of this contract were to investigate electro-optical methods of modulating light at microwave frequencies and to discover methods for detecting such modulation. (Contractor's abstract)

1279

Illinois U. [Electrical Engineering Research Lab.] Urbana.

A GENERAL SYNTHESIS OF TUNNEL DIODE AMPLIFIERS AND SENSITIVITY MINIMIZATION, by B. A. Shenoi. [1962] [13]p. incl. refs. (AFOSR-3860) AF 49(638)63 and AF AFOSR-62-126) Unclassified

Presented at Nat'l. Electronics Conf., Chicago, Ill., Oct. 8-10, 1962.

Also published in Proc. Nat'l. Electronics Conf., v. 18: 114-124, Oct. 1962.

Several authors have studied lossless networks with 1 or more tunnel diodes embedded as active elements. In this paper, a different technique of synthesizing a grounded network which (1) is lossy, (2) realizes transfer function poles and zeros anywhere in the finite s-plane, (3) requires at most 2 tunnel diodes and (4) can be provided with different amounts of dissipation in the capacitors and inductors, is described. The transfer characteristic of the network so designed is not affected by biasing the diodes, since a DC bias can be applied to them through an integral part of the network. A decomposition of a given polynomial N(s) to realize its zeros as the natural frequencies of a lossy network is described such that (1) the ratio $|\frac{-G}{C}|$ of the diode embedded in it and (2) the coefficient sensitivity of N(s) due to variation in -G are simultaneously minimized. Necessary and sufficient conditions for realizability of these natural frequencies by a tunnel diode with prescribed parameters C and -G are derived. Minimization of the zero sensitivity due to variation in -G, for the above decomposition of N(s) is also investigated. (Contractor's abstract)

1280

Illinois U. [Electrical Engineering Research Lab.] Urbana.

MILLIMETER WAVE CAVITY COUPLING BY QUARTER-WAVE TRANSFORMER, by R. J. Strain and P. D. Coleman. [1962] [3]p. incl. diagrs. tables. (AFOSR-J507) (AF AFOSR-62-287) AD 407875 Unclassified

Also published in I. R. E. Trans. on Microwave Theory and Techniques, v. MTT-10: 612-614, Nov. 1962.

In order to use high mode-order microwave cavities to achieve either field intensities or high selectivity with low transmission losses, it is necessary to couple power into the resonators efficiently. This may be

accomplished if the coupling system acts as a transformer matching the lossy elements of the cavity to a source of input power, and if the coupling system has an aperature large enough to make diffraction losses negligible. This note describes an easily designed coupler which satisfies these requirements. It is essentially a series iteration of parallel plane waveguides, each $\lambda/4$ long. The fundamental design principles of this coupler are described to the particular case of a bisected confocal resonator. Experimental evaluation verifies the efficacy of both the transformer and the approximations used in its design.

1281

Illinois U. [Electrical Engineering Research Lab.] Urbana.

ULTRAMICROWAVE RESEARCH AT THE UNIVERSITY OF ILLINOIS, by M. D. Sirkis. [1962] [34]p. incl. illus. diagrs. refs. (AF AFOSR-62-287) Unclassified

The difficulties associated with the extension of conventional vacuum tube techniques to the generation of ultramicrowaves arise principally from the small physical size of the component parts of the resulting devices. This is a report on how the microwave group at the University of Illinois solved the major problems for self-excited devices: (1) The fabrication of the devices is difficult because of the small size of the component parts; (2) The required beam current densities become extremely high as the cathode area is decreased; (3) The circuit losses increase in inverse proportion to the square root of the wavelength; and (4) Adequate cooling of the small internal structures becomes increasingly difficult as the wavelength is decreased.

1282

Indiana U. Dept. of Chemistry, Bloomington.

STATISTICAL THEORY OF THE ERROR IN APPROXIMATE WAVEFUNCTIONS, by G. G. Hall. [1962] [5]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638) 318] and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 38: 1104-1108, Mar. 1, 1963.

The theory of how a probability distribution may be estimated by sampling is applied to the problem of using approximate wavefunctions for quantum mechanical systems and estimating the errors involved. The most probable wavefunction of given mean energy is considered and some of its properties found. The energy variance, which gives a lower bound to the true energy, can be calculated. The theory is applied to the simple harmonic oscillator and the predicted relation between mean energy and variance is compared with the actual relations found using 2 different types of approximate wavefunction.

1283

Indiana U. Dept. of Chemistry, Bloomington.

REACTIONS OF NITROGEN-HYDROGEN RADICALS. I. NH_2 RECOMBINATION IN THE DECOMPOSITION OF AMMONIA, by M. H. Hanes and E. J. Bair. [1962] [5]p. incl. diagrs. table, refs. (AFOSR-J617) [AF AFOSR-62-38] Unclassified

Also published in Jour. Chem. Phys., v. 38: 672-676, Feb. 1, 1963.

Photoelectric measurements of NH_2 absorption as a function of time following an rf discharge pulse through ammonia are described. The extinction coefficient of the strong vibration-rotation line at 16725. 40 cm^{-1} is found to be $1.02 \pm 0.10 \times 10^3$ liter mol^{-1} cm^{-1} as an upper limit. Under the proper conditions, the kinetics of NH_2 disappearance is second order with respect to NH_2. Arguments attribute the initial stages of the observed reaction to NH_2 recombination to form hydrazine. The recombination rate constant is $2.33 \pm 0.20 \times 10^9$ liter mol^{-1} sec^{-1} and is independent of the total pressure in the range 425 to 850 μ.

1284

Indiana U. Dept. of Chemistry, Bloomington.

THE THEORY OF ELECTRON SCATTERING FROM MOLECULES. I. THEORETICAL DEVELOPMENT, by T. Iijima, R. A. Bonham, and T. Ando. [1962] [3]p. (Contribution no. 1109) (AFOSR-64-1496) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-322) and Atomic Energy Commission) AD 446126 Unclassified

Also published in Jour. Phys. Chem., v. 67: 1472-1474, July 1963.

The quantum theory of electron scattering from molecules in the gas phase is developed. Expressions which include the effects of chemical binding are presented and the intensity averages to be expected for various types of experiments are discussed in terms of the theory. The quantum mechanical average over the rotational states of the molecule is shown to be reducible to the classical method of averaging rotational motion except in the case of extremely high energy resolution of the scattered electrons. (Contractor's abstract)

1285

Indiana U. Dept. of Chemistry, Bloomington.

THEORY OF THE EFFECT OF TEMPERATURE ON THE ELECTRON DIFFRACTION PATTERNS OF DIATOMIC MOLECULES, by R. A. Bonham and J. L. Peacher. [1962] [7]p. incl. tables, refs. (Contribution no. 1106) (AFOSR-64-1501) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-322 and Atomic Energy Commission) AD 446360 Unclassified

Also published in Jour. Chem. Phys., v. 38: 2319-2325, May 15, 1963.

The effect of temperature on the electron diffraction pattern of a diatomic molecule is considered from the standpoint of the simple kinematic scattering theory utilizing a quartic vibrational potential. The potential is obtained by an expression of

$$h^2 J(J+1)/2\mu r^2 + D \exp[-2a(r-r_e)] - 2D \exp[-a(r-r_e)]$$

about its minimum value r_0. The second-order wavefunction for the n'th vibrational and J'th rotational state of the system has been obtained, and expressions for the electron diffraction quantities r_g, l_e^2 and (Ms) have been computed. General results for the quantity M(s) utilizing the approximate eigenfunctions of the complete Morse potential and incorporating an approximate treatment of the effect of centrifugal stretching are also presented. Explicit expressions for M(s) for the first 3 vibrational states as derived by this treatment are given. Appropriate sums over all the vibrational and rotational states have been carried out to obtain the temperature dependence for the above quantities. Estimates of the effect of temperature on the parameters r_q and l_e^2 at 300° and 1500°K for representative diatomic molecules are given. (Contractor's abstract)

1286

Indiana U. Dept. of Chemistry, Bloomington.

ELECTRON PAIRS IN THE BERYLLIUM ATOM, by T. L. Allen and H. Shull. [1962] [3]p. incl. refs. (AFOSR-64-1521) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-362 and National Science Foundation) AD 445974 Unclassified

Also published in Jour. Phys. Chem., v. 66: 2281-2282, Dec. 1962.

The electron-pair approximation in the beryllium atom is investigated using a properly antisymmetrized product function over geminals (electron-pair wave functions). A wave function of this relatively simple type is obtained having an overlap of 0.9998886 with one of the best published functions, a superposition of 37 configurations. As a consequence of the separation into electron pairs, some of the coefficients in the configuration interaction treatment are found to be interrelated. (Contractor's abstract)

1287

Indiana U. Dept. of Chemistry, Bloomington.

GROUND STATE OF THE HeH^+ MOLECULE ION by B. G. Anex. [1962] [11]p. incl. tables, refs. (AFOSR-64-1524) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-362 and National Science Foundation) AD 446373 Unclassified

Also published in Jour. Chem. Phys., v. 38: 1651-1662, Apr. 1, 1963.

Configuration interaction calculations have been carried out for the system HeH+ using 1-electron basis functions in confocal elliptical coordinates. Four internuclear separations, R = 1.00, 1.40, 1.80, and 2.20 bohrs (B) were studied rather intensively. One of these, R = 1.40 B, lies very close to the equilibrium R and the energies found in this region represent the lowest thus far reported for HeH^+. Self-consistent field calculations were also made and in combination with the configuration interaction results lead to an estimation of correlation energies. The binding energy, the equilibrium internuclear separation, and the first few vibrational energies for the system were also estimated. The center of negative charge, which is closely related to the dipole moment, was studied as a function of R and of the size of the 1-electron basis. (Contractor's abstract)

1288

Indiana U. Dept. of Chemistry, Bloomington.

THE NATURE OF THE TWO-ELECTRON CHEMICAL BOND. II. THE HETEROPOLAR CASE, by H. Shull. [1962] [5]p. incl. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-63-362] and National Science Foundation) Unclassified

Published in Jour. Phys., Chem. v. 66: 2320-2324, Dec. 1962.

By using the artifice of dividing space into 2 parts by means of a plane perpendicular to the internuclear axis and passing through its mid-point, it is shown that there is possible a division of a 2-configuration 2-electron wave function into 3 orthogonal parts each of which has optimum properties associated with the plane intuitively corresponding to the names ionic and atomic. The heteropolar case is considered, and it is shown that there arises a natural mathematical quantity, θ, which is a function of 3 integrals over natural orbitals over half space. The quantity, θ, seems to bear a considerable resemblance to electronegativity

difference. An example is given for the simple diatomic hydride 2-electron system, $HZ^{(Z-1)+}$, at a fixed internuclear distance. Finally it is pointed out that the treatment is a special case of the use of a much more general weight factor. Suitable choices of the latter may make it possible to relate functionally the large number of different electronegativity scales. (Contractor's abstract)

1289

Institute for Advanced Study, Princeton, N. J.

[GENERATORS, RELATIONS AND COVERINGS OF ALGEBRAIC GROUPS] Générateurs, relations et revêtements de groupes algébriques, by R. Steinberg. [1962] [15]p. incl. refs. (AFOSR-3307) (AF 49(638)253) Unclassified

Also published in Colloques sur la Théorie des Groupes Algébriques, Brussels (Belgium) (June 5-7, 1962), Louvain-Belgique, Librairie Univeritaire, 1962, p. 113-127.

For each simple group G of normal form (that is to say a group studied by Chevelley and designated as G'), the properties of 2 groups, Γ and Δ, which play the role of the universal covering of the Chevalley group G were studied. From certain non-normal forms of simple groups, which were studied by Hertzig, Tits, Suzuki, Ree, and R. Steinberg, there are analogous results which are presented in this article. These results are of primary importance in the study of the representations of all these groups. (Contractor's abstract)

1290

Institute for Advanced Study, Princeton, N. J.

ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF HYPERBOLIC INEQUALITIES, by M. H. Protter. [1962] [3]p. (AFOSR-J129) (AF 49(638)253) AD 400191 Unclassified

Also published in Bull. Amer. Math. Soc., v. 68: 523-525, Sept. 1962.

Let D be a bounded domain in E^n and R the cylindrical region R = D x I, where I is the half-infinite interval $0 \leq t \leq \infty$. It is considered that the asymptotic behavior as $t \to \infty$ of solutions $u(x_1, x_2, \ldots x_n, t)$ of inequalities having the form $|Lu|^2 \leq C_1 |u|^2 + C_2 \sum_{i=1}^{n} |\frac{\partial u}{\partial x_i}|^2 + C_3 |\frac{\partial u}{\partial u}|^2$ where $L = A - \partial^2 / \partial t^2 + b$ and A is a second order elliptic operator. In addition, the solutions are required to satisfy the condition that $u = 0$ on $\Gamma x I$ where Γ is the boundary of D. (Math. Rev. abstract)

1291

Institute for Advanced Study, Princeton, N. J.

THE LOW-ENERGY TWO-PION PROBLEM, by J. G. Taylor and T. N. Truong. [1962] [6]p. incl. diagrs. table, refs. (AFOSR-64-0633) (AF AFOSR-61-19) AD 435945 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 946-951, Aug. 16, 1962.

Herein is discussed the number of parameters involved, when S and P-wave absorptive parts are prescribed, and to point out some deficiencies in the methods used for solving this problem. A possible approximate set of low-energy solutions for the S and P-wave shifts is also presented.

1292

Institute for Advanced Study, Princeton, N. J.

LEADING REGGE TRAJECTORY IN THE $\lambda \varphi^4$ THEORY, by B. W. Lee and R. F. Sawyer. [1962] [3]p. incl. diagr. (AFOSR-64-0634) (In cooperation with Pennsylvania U., Philadelphia and Wisconsin U., Madison) (AF AFOSR-61-19) AD 435944 Unclassified

Also published in Phys. Rev., v. 127: 2274-2276, Sept. 15, 1962.

In a field-theoretic model of pion-pion scattering it is shown that the leading Regge pole approaches l = 0 as the squared energy approaches ± infinity. (Contractor's abstract)

1293

Institute for Advanced Study, Princeton, N. J.

UNITARITY AND PRODUCTION AMPLITUDES, by L. F. Cook, Jr. and B. W. Lee. [1962] [14]p. incl. refs. (AFOSR-64-0635) (In cooperation with Princeton U., N. J.) (AF AFOSR-61-19) AD 435942 Unclassified

Also published in Phys. Rev., v. 127: 283-296, July 1, 1962.

A development of the N D formulation of the unitary S matrix is presented for multichannel reactions including production processes. The relevant amplitudes are expressed in terms of helicity amplitudes and the coupled, unitarity relations of Blankenbecler. The analytic continuation of the amplitudes in the presence of anomalous thresholds is considered in detail. An extension of the Levinson theorem to the multichannel production case is discussed. An application of the formalism developed here is given in another paper. (Contractor's abstract)

1294

Institute for Advanced Study, Princeton, N. J.

AXIOMATIC PERTURBATION THEORY FOR RETARDED FUNCTIONS, by H. M. Fried. [1962] [9]p. (AFOSR-64-0778) (AF AFOSR-61-19) AD 438243 Unclassified

Also published in Jour. Math. Phys., v. 3: 1107-1115, Nov.-Dec. 1962.

A construction of the retarded n-point functions of perturbation theory is given within the Lehmann, Symanzik, and Zimmerman framework and without the specification of an interaction Lagrangian. An intermediate-state expansion of retarded functionals is employed to define a systematic set of equations representing approximations to the (integral) unitarity conditions; the requirement of symmetry of the n- 1 retarded coordinates of an n-point retarded function enters in an essential way. The class of solutions to these equations contains the renormalized perturbation theory retarded functions corresponding to local renormalizable Lagrangian interactions, as well as more singular functions corresponding to nonrenormalizable interactions; if the latter are excluded all the n-point functions may be successively determined to all orders in the renormalized coupling constants. The construction is explicity performed for the first radiative corrections to the 2- and 3-point functions of a self-interacting neutral scalar boson field, yielding the finite renormalized results of perturbation theory. Similar but slightly singular results are quoted for the π - π scattering amplitude. (Contractor's abstract)

1295

Institute for Advanced Study, Princeton, N. J.

ANALYTICITY AND UNITARITY. II, by J. C. Polkinghorne. [1962] [11]p. incl. diagrs. refs. (AFOSR-64-0779) (AF AFOSR-61-19) AD 438244 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 901-911, Aug. 16, 1962.

A previous discussion of the singularities of unitary theories is amplified. A derivation Cutkosky's formula for the discontinuity of first type Landau singularities is given without recourse to perturbation theory. The discontinuities associated with second type singularities are discussed. Their form is completely determined once the pure second type discontinuity is known. (Contractor's abstract)

1296

Institute for Advanced Study, Princeton, N. J.

PI-NUCLEON SCATTERING WITH INELASTIC CONTRIBUTIONS, by L. F. Cook, Jr. and B. W. Lee. [1962] [15]p. incl. diagrs. refs. (AFOSR-64-0780) (In cooperation with Princeton U., N. J.) (AF AFOSR-61-19) AD 438245 Unclassified

Also published in Phys. Rev., v. 127: 297-311, July 1, 1962.

The N/D formulation of the unitarity S matrix, valid for reactions involving production processes, is applied to the reactions, $\pi + N \to \pi + N$, $\pi + N \to \pi + \pi + N$, $\pi + \pi + N \to \pi + \pi + N$, in the energy region of the higher resonances. A model is constructed in which the 2-pions in 3-particle states interact in only 1 state, and the left-hand discontinuities of the elastic and 3-particle scattering amplitudes are neglected while the left-hand discontinuities of the production amplitude are approximated by a pole. The elastic amplitude is driven through unitarity by the inelastic amplitude. The general properties of this model are investigated, and the procedure is applied to the D- and F-wave scattering of the π - N system. The comparison between the experimental data and the model presented here is quite favorable. (Contractor's abstract)

1297

Institute for Advanced Study, Princeton, N. J.

SYMMETRY MODEL FOR THE NEW RESONANCES, by R. F. Sawyer. [1962] [3]p. incl. tables. (AFOSR-64-0781) (AF AFOSR-61-19) AD 438246 Unclassified

Also published in Phys. Rev., v. 128: 988-990, Oct. 15, 1962.

A global symmetry is proposed which produces what seems to be a sensible classification of boson resonances and of $N, ^{*}$ Y^{*} resonances. A noval feature is the prediction that the cascade particle be spin 3/2.

1298

Institute for Advanced Study, Princeton, N. J.

REGGE POLES AND HIGH-ENERGY LIMITS IN FIELD THEORY, by B. W. Lee and R. F. Sawyer. [1962] [8]p. incl. refs. (AFOSR-64-0782) (In cooperation with Pennsylvania U., Philadelphia and Wisconsin U., Madison) (AF AFOSR-61-19) AD 438247 Unclassified

Also published in Phys. Rev., v. 127: 2266-2273, Sept. 15, 1962.

It is shown that the Bethe-Salpeter scattering amplitude in the ladder approximation is meromorphic in the complex angular momentum half-plane, Rel > - 3/2. There is always at least 1 Regge pole in this region. The connection between the Regge poles of the ladder graphs and the high-energy behavior of the strip graphs is discussed. In the $\lambda\varphi^3$ theory it is shown that the

second-order expression for the leading Regge trajectory, for the sum of the ladder graphs, determines the leading term in the high-energy limit of the n'th order strip graph. This relationship has been checked in fourth-order perturbation theory, and is evidence for the consistency of a perturbation approach to the calculation of Regge trajectories. (Contractor's abstract, modified)

1299

Institute for Advanced Study, Princeton, N. J.

SINGULARITIES OF THE SECOND TYPE, by D. B. Fairlee, P. V. Landshoff and others. [1962] [9]p. incl. refs. (AFOSR-64-0783) (AF AFOSR-61-19) AD 438248 Unclassified

Also published in Jour. Math. Phys., v. 3: 594-602, July-Aug. 1962.

A new class of singularities associated with Landau-Cutkosky diagrams is investigated. They correspond to solutions of the Laudau equations with infinite internal momenta. Some of their properties depend on the spins of the participating particles. It is shown that a subset of these singularities, called pure second-type singularities, does not appear on the physical sheet.

1300

Institute for Advanced Study, Princeton, N. J.

POSSIBLE SCHEMES FOR GLOBAL SYMMETRY, by D. R. Speiser and J. Tarski. [1962] [25]p. incl. diagrs. tables, refs. [AF AFOSR-61-19] Unclassified

Published in Jour. Math. Phys., v. 4: 588-612, May 1963.

An attempt was made to determine all possible schemes for global symmetry as representations of groups. All possible schemes which correspond to connected groups were found, but the conclusions about nonconnected groups are incomplete. Physical interpretation of the schemes is discussed, and a detailed summary of group-theoretic methods is included. (Contractor's abstract)

1301

Institute for Advanced Study, Princeton, N. J.

DIFFEOMORPHISMS OF MANIFOLDS, by W. Huebsch and M. Morse. [1962] [28]p. (AFOSR-5081) (AF AFOSR-62-227) AD 416505 Unclassified

Also published in Rend. Circ. Matem. Palermo, v. 11: 1-28, 1962.

Problems in the theory of analytic diffeomorphisms of manifolds, and of analytic homotopies and isotopies on manifolds, can be approached in a new way by extending to manifolds the results obtained in a recent paper. It is the object of this paper to make such an extension. With the aid of the theorems here established, it is, in particular, possible to extend to open non-compact analytic manifolds the theorems on analytic homotopies obtained by Royden in the compact case.

1302

Institute for Advanced Study, Princeton, N. J.

THEORY OF THE $J = \frac{3}{2}$, $I = \frac{3}{2}$ π N RESONANCE, by V. Singh and B. M. Udgaonkar. [1962] [3]p. incl. diagr. refs. (AFOSR-64-0800) (AF AFOSR-63-42) AD 436476 Unclassified

Also published in Phys. Rev., v. 130: 1177-1179, May 1, 1963.

Calculations are made on the position W_R and width γ_{33} of the $J = \frac{3}{2}$, $I = \frac{3}{2}$ P-wave π N resonance, using partial-wave dispersion relations. In the present calculation, the nucleon and ρ-meson masses and coupling constants, which determine the long-range part of the forces, are treated as given. The parameters which characterize the distant part of the left-hand cut, are fixed by using the expressions for the $(\frac{3}{2}, \frac{3}{2})$ P-wave πN state given by fixed energy dispersion relations, in a region where they are valid without substractions, in a way used by Balázs for the $\pi\pi$ problem. The self-consistency demands that the position and width of the $(\frac{3}{2}, \frac{3}{2})$ resonance used as input values in the crossed channel in the fixed-energy dispersion relation be the same as the calculated values of the position and width. The preliminary results of the calculation are $W_R \approx m + 2.35$ and $\gamma_{33} \approx 0.14$. The experimental values are $W_R = m + 2.17$ and $\gamma_{33} \approx 0.12$, (where m is the nucleon mass and we use units in which $\hbar = c = m_\pi = 1$). These results constitute the first part of the intended self-consistent calculation of the nucleon mass and $(\frac{3}{2}, \frac{3}{2})$ resonance position, exploiting the "reciprocal bootstrap" mechanism discussed by Chew. (Contractor's abstract)

1303

Institute for Scientific Information, Philadelphia, Pa.

WHAT SHOULD A RETRIEVAL SYSTEM FOR SCIENTIFIC INFORMATION DO, by J. J. O'Connor. [1962] [3]p. (AFOSR-J782) [AF AFOSR-62-257]
AD 413708 Unclassified

Also published in I. R. E. Trans. on Eng. Writing and Speech, v. EWS-5: 75-77, Dec. 1962.

Some difficulties in getting answers as to what should a retrieval system for scientific information do are sketched. For example, there exists a lack of knowledge about the true relationship of scientific literature and scientific discovery, and the differences in form and language used in various specialized fields. Some areas of needed research on retrieval systems for scientific information are suggested.

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 Air Flight Structures, New York.
see Columbia U. Inst. of Air Flight Structures, New York.

1304

Instituto de Matematica Pura e Aplicada, Rio de Janeiro (Brazil).

[THE SOLUTION OF A FUNDAMENTAL PROBLEM IN THE THEORY OF DIFFERENTIAL EQUATIONS] Sobre o problema fundamental de teoria das equacoes diferenciais, by M. M. Peixoto. [1962] [5]p. (AFOSR 66-0031) [AF AFOSR-62-334] AD 631133
Unclassified

Also published in Summa Brazil. Math., v. 5: 190-194, 1962.

The importance of the concept of structural stability in the general theory of differential equations on a manifold is illustrated. An explicit proof is given for the fact that in a compact manifold there are only denumerable many topologically distinct types of structurally stable systems.

1305

Instituto de Neurologia, Montevideo (Uruguay).

INFLUENCE OF THE OCULAR MUSCLES UPON PHOTIC HABITUATION IN MAN, by E. García-Austt, A. Vanzulli and others. [1962] [6]p. incl. illus. refs. (AFOSR-J934) (AF AFOSR-61-65) AD416595
Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol., v. 15: 281-286, Apr. 1963.

Changes of visual evoked response (VER) were studied in 24 experiments carried out in 21 normal men, in 2 patients with congenital aniridia, and in one with complete ocular paralysis. The pupillary diameter was controlled, in all the experiments performed in normals, photographically, pharmacologically or with a 2-mm artificial pupil. The unchanged position of the head, eyeballs and eyelids was photographically checked throughout the experiments. One eye was stimulated with flashes of light at 0.5-1/sec and at a constant intensity. The response was recorded from the scalp and averaged with a photoelectric method. Waning of VER accompanying habituation was observed with maximal fixed miosis or mydriasis provoked by drugs and also with an artificial pupil. Patients with congenital aniridia and with complete ocular paralysis showed a significant reduction of VER amplitude during habituation. The same changes elicited by habituation were observed either with eyes open or closed. Under the experimental conditions established, the pupillary diameter did not undergo spontaneous changes during habituation. It is concluded that in man the pre-receptor elements do not participate decisively in the mechanism of VER reduction observed during photic habituation.

1306

Instituto Geofisico de Huancayo, Lima (Peru).

ON THE CENTER-LIMB EFFECT OF SOLAR FLARE AREA, by O. Takahashi. 1962, 37p. incl. diagrs. tables, refs. (AF 49(638)637) AD 423787; AD 437507
Unclassified

The visual flare area has been corrected to obtain a real flare area. As the result of this correction, however, great discrepancy was brought into the distribution of flare area with respect to central distance on disk, and this discrepancy has been explained as due to the flare height. This paper gives an actual proof of the existence of 2 different parts in the foreshortening effect of flare visual area and then gives the normalized correction of flare area, from the distribution of the flare counted number with respect to the central distance on disk. These 2 different parts are the well-known geometrical distorsion and the vanishing effect near the limb. (Contractor's abstract)

1307

Instituto Geofisico de Huancayo, Lima (Peru).

STATISTICS OF SOLAR FLARES. PART I, by O. Takahashi. 1962, 15p. incl. diagrs. tables. (AF 49(638)637) AD 433789; AD 437509
Unclassified

The purpose of this note is to provide more detailed information on various characteristics of solar flares,

by means of statistical methods, to help in a better theoretical understanding of them. The solar flare's lifetime, area, H-α width, development curve, associated filament activation and associated sunspot group characteristics are analyzed for each of 685 flares observed. Correlation of these parameters with one another and with flare importance and solar activity is shown, as well as the frequency distribution. (Contractor's abstract)

1308

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

ON THE INFLUENCE OF CHEMICAL KINETICS ON THE COMBUSTION OF FUEL DROPLETS, by C. S. Tarifa. Mar. 10, 1962 [39]p. incl. illus. diagrs. refs. (Technical note no. 5) (AFOSR-2836) (AF 61(052)221) AD 277299 Unclassified

Presented at Internat'l Cong. of Combustion Engines, Copenhagen (Denmark), June 1962.

The influence of chemical kinetics on the combustion of fuel droplets is studied by means of a theoretical model of the process which considers spherical symmetry and quasi-stationary conditions. Chemical kinetics is approximated by means of a second-order over-all reaction rate. Results are expressed as a function of the product pr_g, where p is the pressure and r_g the droplet radius. It is shown that there exists a minimum value of such product under which an individual droplet cannot sustain a flame. An experimental investigation was also carried out, by burning in air at variable pressure fuel droplets suspended of thin quartz fibres. The laws of variation of both flame and droplet diameter as functions of time were obtained as well as the minimum values of the droplet diameters for combustion as a function of pressure. It is shown that all experimental results are in excellent qualitative agreement with those predicted by theory. (Contractor's abstract)

1309

Instituto Nacional Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

COMBUSTION OF SOLID AND LIQUID PROPELLANTS AND FLAME THEORY, by C. S. Tarifa. Final rept. Feb. 1, 1959-Mar. 31, 1962. May 1, 1962, 15p. incl. refs. (AFOSR-3197) (AF 61(052)221) AD 282440 Unclassified

An analytical study on the influence of chemical kinetics on the combustion of liquid bipropellant in droplets, was undertaken. The influence of chemical kinetics on premixed and diffusion spherico-symmetrical flames has also been theoretically and experimentally studied. A research facility was constructed and experiments were carried out in order to study the influence of pressure and temperature of the surrounding atmosphere on solid propellant combustion. A theoretical study on the influence of heat losses and radical diffusion on the structure of premixed flames was carried out. A criterion for the validity of the steady state assumption for radical concentration has been obtained. And, in order to study the influence of chemical kinetics on laminar diffusion flames, their external and internal structures have been analyzed. As a result a criterion for flame extinction was obtained. (Contractor's abstract)

1310

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

CHEMICAL NON-EQUILIBRIUM EFFECTS IN HYPERSONIC AERODYNAMICS, by A. Linan and I. Da Riva. [1962] 31p. incl. diagrs. refs. (AFOSR-4365) (AF 61(052)221) AD 294638 Unclassified

Presented at Third Internat'l. Cong. in the Aeronautical Sciences, Stockholm (Sweden), Aug. 27-31, 1962.

The influence of chemical non-equilibrium on hypersonic flows is considered in the following cases: recombination and dissociation in the boundary layer. It is pointed out that since in the region of maximum convective heating, the outer inviscid flow is in equilibrium, departures from equilibrium occur only close to the wall, and this makes possible the obtention of a simple analytical solution in which the effects of arbitrary reaction rates, body shapes and flight regimes are clearly shown. Chemical reactions between the air constituents and any injected or vaporized material from the wall. In this case, the assumption is made that the chemical reaction is so fast thati it takes place in a very thin region. This simplifies the obtention of an analytical solution for finite reaction rate. A criterium for flame extinction is given. (Contractor's abstract)

1311

Instituto Nacional de Tecnica Aeronautica [Esteban Terradas] Madrid (Spain).

ON THE STRUCTURE OF PREMIXED AND DIFFUSION LAMINAR SPHERICO-SYMMETRICAL FLAMES, by Pefez del Notario and C. S. Tarifa. [1962] [7]p. incl. diagrs. table, refs. (AFOSR-3196) (AF EOAR-62-90) AD 282387 Unclassified

Also published in Ninth Symposium (International) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 65-71.

Premixed and diffusion laminar spherico-symmetrical flames are studied by means of a non-adiabatic model

which considers variable temperature at infinity. The flame is supposed to be maintained by a porous sphere through which the gaseous mixture or one of the reactant gases is injected. Stationary conditions are assumed and chemical kinetics of the process is approximated by means of an overall reaction rate. Solution of the problem is achieved by means of an approximate analytical method. Flame temperature, mass flow per unit area at the flame surface, thickness and radius of the flame and temperature at the sphere surface are given as functions of the mass flow. The influence of the main parameters of the process: temperature at infinity, dimensionless ratio of the activation energy to the heat of reaction and sphere radius is also considered. Some experimental results for diffusion flames are also given. (Contractor's abstract)

1312

Instituto Technológico de Aeronáutica, São Paulo (Brazil).

SUPERSONIC FLOW ABOUT AXIALLY SYMMETRICAL DIFFUSERS, by J. Sielawa. Nov. 20, 1962, 68p. incl. diagrs. (AFOSR-4729) (AF 49(638)581)
AD 406433 Unclassified

This report describes applications of the method of characteristics to supersonic flow about axially symmetrical, open-nosed bodies, such as diffusers. A general procedure is given for the computation of velocity distributions on the external surface of axially symmetrical diffusers of arbitrary shape. The case of straight-line diffusers is developed in more detail, including the case with incidence. A special function is introduced which allows a quick analytical solution of the problem of straight-line diffusers. (Contractor's abstract)

1313

International Business Machines Corp., Yorktown Heights, N. Y.

HIGH-SPEED DOCUMENT PERUSAL, by M. Kochen, C. T. Abraham and others. Final technical rept. Apr. 1, 1961-Apr. 1, 1962. May 1, 1962 [92]p. incl. diagrs. table, refs. (AFOSR-2817) (AF 49(638)1062)
AD 285255 Unclassified

Five results concerning the possibility of high-speed document perusal are given. These are: (1) derivation of a formula for the average time to search an index; (2) algorithms for translating English-like sentences into logic-like sentences; (3) development of efficient techniques for grouping similar texts; (4) implementation of a high-speed automatic dictionary lookup procedure; and (5) construction of computer programs for constructing representative abstracts and index terms. These constitute some first steps toward experimentally demonstrating the feasibility of a cooperative man-machine system for high-quality, high-speed perusal of large document collections; also, toward solving some of the basic logico-linguistic problems in the way of more completely automatic, high-quality perusal. (Contractor's abstract, modified)

1314

International Business Machines Corp., Yorktown Heights, N. Y.

AN ENGLISH-LIKE EXTENSION OF AN APPLIED PREDICATE CALCULUS, by H. Bohnert. Feb. 1962 [14]p. (Bound with its AFOSR-2817; AD 285255) (AF 49(638)1062) Unclassified

While full translation of natural language into symbolic logic may be unattainable, translation of an artificial language resembling English should be possible. As a first step toward developing such an artificial, English-like language, the present paper develops an extension of an applied logic, LII, in which phrases like "every ship", "any port", "a business-man", "some weapon", "no missle" (which Quine has called indefinite singular terms) act syntactically like names but are not candidates for logical substitution. An algorithm is given for translating sentences of LII into LI, thereby making explicit the variables and the logical quantifications implicit in the original English (-like) locutions.

1315

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

BISTABLE SYSTEMS OF DIFFERENTIAL EQUATIONS WITH APPLICATIONS TO TUNNEL DIODE CIRCUITS, by J. K. Moser. [1961] [15]p. incl. diagrs. (AFOSR-3705) [AF 49(638)1139] Unclassified

Also published in IBM Jour. Research and Develop., v. 5: 226-240, July 1961.

A mathematical analysis is developed for nonlinear circuits which have at least 2 stable steady states, and therefore are of interest as computing or memory elements. Circuits containing 1 or 2 tunnel diodes are analyzed in detail as applications of the theory. The method is based on the study of a certain potential function whose extrema are the steady states of the circuit and whose minima correspond to the stable switching states. This study leads to a qualitative description of all solutions in the large and results in quantitative restrictions on the parameters (R, L, C and nonlinear characteristics) which seem of practical importance. (Contractor's abstract)

1316

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

AN ANALYSIS OF THE EFFECT OF COMPONENT

TOLERANCES ON THE AMPLIFICATION OF THE BALANCED-PAIR TUNNEL-DIODE CIRCUIT. PART I, by R. Brayton and R. Willoughby. Apr. 9, 1962, 28p. incl. diagrs. (Rept. no. RC-673) (AFOSR-3706) (AF 49(638)1139) Unclassified

A study was made to determine, for the balanced-pair tunnel-diode circuit, the minimum amount of control required when specified parameter imbalances are present in the system. The geometrical aspects of the problem and some numerical experiments in which the minimum control is determined are discussed. (Contractor's abstract, modified)

1317

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

AN ANALYSIS OF THE EFFECT OF COMPONENT TOLERANCES ON THE AMPLIFICATION OF THE BALANCED-PAIR TUNNEL-DIODE CIRCUIT, PART II, by R. Brayton. July 2, 1962, 28p. incl. diagrs. (Rept. no. RC-721) (AFOSR-3707) (AF 49(638)1139 Unclassified

The mathematical details of the analytical approach to the effect of component tolerances are presented, and how perturbation theory can be applied to almost symmetrical systems is illustrated. The results obtained may be stated in terms of allowable tolerances on the circuit components for a given requirement on the maximum amplification. (Contractor's abstract, modified)

1318

International Business Machines Corp. [Thomas J. Watson] Research Center, Yorktown Heights, N. Y.

ESTIMATES ON SWITCHING TIME IN A CIRCUIT CONTAINING ONE ESAKI DIODE, by R. Brayton. Sept. 16, 1960, 40p. incl. diagrs. (Rept. no. RC-338) (AFOSR-3709) (AF 49(638)1139) Unclassified

A procedure to estimate switching times in a memory circuit which uses an Esaki diode is outlined. Formulas are derived which display the influence of the parameters of the circuit on the switching time. The results of programming this procedure on the IBM 704 are exhibited and discussed. (Contractor's abstract)

1319

Iowa State U. [of Science and Tech.]. Dept. of Chemistry, Ames.

AUTOXIDATION AND CONDENSATION REACTIONS OF CARBANIONS IN DIMETHYL SULFOXIDE SOLUTION, by G. A. Russell, E. G. Janzen and others. [1962] [2]p. incl. tables. (AFOSR-J1154) (Supported jointly by Air Force Office of Scientific Research under AF 49(638)678 and Petroleum Research Fund) AD 423129 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 2652-2653, July 5, 1962.

A study was made of the condensation and addition reactions involving dimethyl sulfoxide (DMSO). The results indicated that the reaction of an active methylene compound with an aldehyde in t-BuOK-DMSO solution proceeded via the aldehyde-dimethyl sulfoxide adduct if the acidic methylene compound was a very weak acid, but when a more acidic methylene compound was used, direct condensation between the aldehyde and the active methylene compound occurred. Attempts to bring about similar condensations using diaryl ketones in place of benzaldehydes gave only the ketone or the dimethyl sulfoxide adduct of the ketone, regardless of the nature of the methylene group.

1320

Iowa State U. of Science and Tech. Dept. of Physics, Ames.

ELECTRIC FIELD EFFECT ON SOUND DISPERSION, by J. R. Olson, R. R. Boade and S. Legvold. [1962] [1]p. (AFOSR-1975) [AF AFOSR-61-87] Unclassified

Also published in Jour. Chem. Phys., v. 36: 2233, Apr. 15, 1962.

A study was made of the effect of an electric field on the vibrational relaxation times of some heavy gases at 300°K. An electric field of up to 9 kv/cm was applied in the hope of producing partial alignment of the polar molecules. In all of the gases examined, no detectable change in node position occurred. It was concluded that an electric field of this strength had no appreciable effect, but did not preclude the possibility that a stronger field might affect the relaxation time.

1321

Iowa State U. of Science and Tech. Dept. of Physics, Ames.

HEAT CAPACITY LAG IN HEAVY GASES, by S. Legvold and J. R. Olson. Final rept. June 1962, 2p. (AFOSR-2766) (AF AFOSR-61-87) AD289435 Unclassified

The aim of this investigation was to determine which of the following equations relating the relaxation times should be used to describe mixtures of non-dispersive gases with dispersive gases. The equations are:

$$\frac{1}{\theta} = \frac{1-x}{\theta_{AA}} + \frac{x}{\theta_{AB}} \quad (1) \quad \text{and} \quad \frac{1}{\theta} = \frac{(1-x)^2}{\theta_{AA}} + \frac{x(x-1)}{\theta_{AB}} \quad (2).$$

Argon, neon, and helium were the non-dispersive gases

used in this study while ethylene, carbon tetrafluoride, fluoroform, and dichlorodifluoro-methane were the dispersive gases. Various per cent mixtures were examined at room temperature. From results tabulated, it appears as if equation (1) is the better equation although some of the mixtures fit either equation equally as well.

1322

Iowa State U. [of Science and Tech.] Dept. of Physics, Ames.

SOUND DISPERSION IN ETHANE-ETHYLENE MIXTURES AND IN HALO-ETHANE GASES, by L. M. Valley and S. Legvold. [1962] [5]p. incl. diagrs. tables, refs. [AF AFOSR-61-87] Unclassified

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 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)

1323

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. Final rept. Mar. 1962, 16p. incl. table, refs. (AFOSR-3763) (AF 61(052)121) AD 288054 Unclassified

The structure of interpersonal behavior and the dynamics of social interaction were studied. Results achieved were: (1) The application of facet design and analysis led to theoretical developments which were strongly confirmed by empirical results; (2) The concept of semantic principal component developed has strengthened the potential value of facet theory; (3) The new structure of interpersonal behavior, which was found, has classified, systematized and integrated a good deal of previous work in this area; (4) Some concepts for a better understanding of the way people deal with each other were provided; and (5) The model of social interaction developed and tested has narrowed the gap between laboratory models and real life situations.

1324

Israel Inst. of Applied Social Research, Jerusalem.

THE STRUCTURE OF INTERPERSONAL BEHAVIOR IN THE DYAD, by U. G. Foa. [1962] 14p. incl. tables. (AFOSR-J256) (AF 61(052)121) AD 407860 Unclassified

Also published in Mathematical Methods in Small Group Processes; A Symposium, Stanford U., Calif. (June 20-23, 1961), ed. by J. H. Criswell, H. Solomon and P. Suppes. Stanford U. Press, 1962, p. 166-179.

Recent findings in support of the structural theory are presented. The contiguity principle is modified by introducing the new concept of semantic principal component and applied to behavior in the dyadic relation. In substance, the problem is to devise concepts for classifying behavior in such a way that the definition of the categories and the use of a metatheoretical principle will predict their statistical interrelation. The main findings concluded by this study are: (1) A new concept for ordering variables, the semantic principal component, has been introduced and its usefulness proved; (2) A close fitting of the theoretical and empirical structure of interpersonal behavior has been achieved; and (3) The circle of interpersonal behavior provides a starting point for extending the map of the interpersonal relations to include other variables such as general and sexual satisfactions.

1325

Israel Inst. of Applied Social Research, Jerusalem.

DYADIC INTERACTION: THEORY AND EXPERIMENT, by U. G. Foa [1961] 2p. [AF 61 (052)121] AD 632013 Unclassified

Presented at Sixteenth Internat'l. Cong. of Psychology, Bonn (Germany) July 31- Aug. 6, 1960.

Also published in Acta Psychol., v. 19: 457-468, 1961.

The report outlines a program of theoretical and empirical research dealing with social learning in the dyad, which attempts to describe and predict how the behavior of a person changes as the result of his interaction with another person. Some of the problems investigated are: (1) The development of systematic categories or a conceptual structure for the classification of interpersonal behavior; (2) The provision of a metatheory—the contiguity principle—for predicting empirical results from the conceptual structure; (3) The analysis of the interpersonal structure; and (4) The relation of behavioral to interpersonal structures.

Israel Inst. of Tech., Haifa.
see Technion - Israel Inst. of Tech., Haifa.

1326

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

ON THE RELATION BETWEEN FROZEN POLARIZATION AND ELECTROLUMINESCENCE OF ZnS CELLS, by G. Bonfiglioli, P. Brovetto, and R. Malvano. Summary rept. Part B, Jan. 1962 [20]p. incl. diagrs. (AFOSR-2321, pt. B) (AF 61(052)328) AD 274008 Unclassified

The kinetics of the decay of the frozen polarization shown by an electroluminescent cell (ELC) after excitation with a suitable waveform of electrical potential has been studied as a function of temperature between 7° and 42.5°C. The order of the kinetics was evaluated as well as the thermal activation energy, which turned out to be around 2.5 ev. This figure corresponds closely to the ionization energy of Cu^+ impurities in ZnS(Cu) phosphor. The kinetics of the decay of the amount of light which an ELC gives out under excitation by a single linear voltage transient retarded on variable amounts with respect to a previous excitation were investigated. The latter consisted of a train of linear transients long enough to saturate the cell. The phenomenon has been followed from -44.5° to +47.5°C, and again an activation energy has been found of roughly 1.5 ev. The connection between these 2 experiments and its possible implications are briefly discussed to cast some light on the mechanism of barrier injection of carriers in EL phosphors. (Contractor's abstract)

1327

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

CALCULATIONS ABOUT BARRIER-INJECTION ELECTROLUMINESCENCE, by G. Bonfiglioli, P. Brovetto, and A. Suardo. July 1962, 22p. incl. diagrs. (Technicl note no. 7) (AFOSR-3442) AF 61(052)328) AD 284386 Unclassified

A calculation is given of the current flowing across a condenser- type electroluminescent cell excited with a constant- slope voltage transient. This is the waveform used in preliminary experiments. The theory followed in this calculation is that advanced by Zalm, whereby tunnel effect at a surface barrier of finite cross extension is invoked. On these grounds, equations are developed which give the shape of the light pulse produced by the EL cell undergoing a linear transient of electrical potential. (Contractor's abstract)

1328

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy)

ELECTROLUMINESCENCE OF ZnS EXCITED WITH LINEAR VOLTAGE TRANSIENTS, by G. Bonfiglioli, P. Brovetto, and C. Cortese. [1962] [7]p. incl. diagrs. (AFOSR-3767) (AF 61(052)328) AD 611506 Unclassified

Also published in Luminescence of Organic and Inorganic Materials; Internat'l. Conf., New York U., N. Y. [1961] ed. by H. P. Kallmann and G. M. Spruch. New York, Wiley & Sons, 1962, p. 605-611.

Commercial cells of ZnS: Cu, Cl, mostly cubic phase, were excited with single transients of voltage, both rising and falling, where dv/dt was constant. The max voltages were 120-220, and the constant dv/dt values were 10 to 10^3 v/msec. The cell was viewed by a 14-dynode photomultiplier through a 150-A -wide interference filter, honeycomb collimator, and either a green-5200 or blue 4700-A filter. The light pulses lasted ~1 msec. The green light emitted was constantly ~5 times the blue in intensity, and the light max for rising voltage were about double those for falling voltage. When the time between voltage pulses is less than 1 sec, the light output is bigger by a factor of several hundred over that obtained at each pulse at intervals of 10 - 15 min. Sufficient recovery was shown at 7-min intervals between single-pulse experiments. The potential barrier at the sulfide grain surface seems modified during the passage of the current.

1329

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy)

NUMERICAL ANALYSIS OF BARRIER-INJECTION ELECTROLUMINESCENCE. Part I, by G. Bonfiglioli, P. Brovetto, and A. Suardo. Final rept. Nov. 1962 [18]p. incl. diagrs. (AFOSR-4581) (AF 61(052)328) AD 401372 Unclassified

Numerical analysis concerning barrier-injection electroluminescence is discussed. The current density through an (admittedly cubic shaped) grain of the phosphor powder, when a linear transient of electrical potential is applied to the whole cell is evaluated. Also the shape of the ensuing light pulse is found. (Contractor's abstract)

1330

Istituto Nazionale di Ottica, Florence (Italy).

EYE DOMINANCE IN AN EMPTY FIELD, by G. F. Mori. [1962] [7]p. incl. tables. (AFOSR-2880) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 55-61, Jan.-Feb. 1962.

Eye dominance is tested by the aid of a series of tests such as the bionocular test, the Jasper's test, the persistency of after images, etc. In addition, the proposal is advanced of testing the differences between the 2 eyes on the basis of the differences between the fluctuations in perception occurring under

prolonged fixation of a test field, with the right eye and with the left eye, respectively. In addition, when faced with an empty field, the subjects perceive the above said fluctuation for a limited number of minutes only, after the beginning of exposure; then, a final situation occurs which, in general, is found to be different for one eye with respect to the other. The discrepancies between the responses obtained by the aid of the various tests are discussed. (Contractor's abstract)

1331

Istituto Nazionale di Ottica, Florence (Italy).

PERIPHERAL DIFFERENTIAL THRESHOLD UNDER PROLONGED FIXATION, by A. M. Ercoles. [1961] [3]p. incl. diagr. (AFOSR-2900) (AF 61(052)80) AD 631895 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 477-479, Sept.-Oct. 1961.

For abstract see item no. 1214, Vol. V.

1332

Istituto Nazionale di Ottica, Florence (Italy).

TRAINING AND ELECTRORETINOGRAPHIC RESPONSES, by L. Ronchi and A. M. Ercoles. [1961] [15]p. incl. diagrs. (AFOSR-2901) (AF 61(052)80; AD 631899 Unclassified

Presented at Symposium of the Internat'l. Soc. for Clinical Electroretinography, Stocknolm (Sweden), June 1-3, 1961.

Also published in Atti Fondazione G. Ronchi, v. 16: 518-531, Sept.-Oct. 1961.

For abstract see item no. 1196, Vol. V.

1333

Istituto Nazionale di Ottica, Florence (Italy).

BINOCULAR INTERACTION EFFECT II: INVESTIGATION ON THE TIME BEHAVIOR OF MONOCULAR SENSITIVITY DURING CONTRALATERAL STIMULATION, by A. Fiorentini and M. Bittini. [1962] [16]p. incl. diagrs. tables, refs. (AFOSR-4172) (AF 61(052)80) AD 632026 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 286-301, May-June 1962.

Illumination of 1 eye has 2 effects on sensitivity in a disparate area of the visual field of the other eye, namely depresses apparent brightness and impairs sensitivity to time increments of luminance. The time courses of both monocular brightness sensitivity and increment sensitivity were investigated in an interval of time including the onset of illumination of the disparate area of the other eye. A comparison is made with the time course of monocular sensitivity during an interval of time including stimulation of a different area of the same eye. In the case of contralateral stimulation, the apparent brightness of a steadily illuminated monocular field is found to decrease by a smaller amount and with a longer delay than in the case of unilateral stimulation. The comparison between the time course of increment monocular sensitivity during contralateral stimulation and the time course of monocular sensitivity during unilateral stimulation shows that, even in the latter case, the changes in differential sensitivity induced by presentation of a conditioning field are partly attributable to nonperipheral inhibitory mechanisms.

1334

Istituto Nazionale di Ottica, Florence (Italy).

TRAINING AND RETINAL LOCATION AFFECTING THE PERIODIC FLUCTUATION OF APPARENT BRIGHTNESS DURING PROLONGED FIXATION, by M. Conticelli. [1962] [9]p. incl. diagrs. table. (AFOSR-4195) (AF EOAR-61-34) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 396-404, July-Aug. 1962.

A 10° in diameter uniform field, surrounded by dark, is steadily gazed in monocular vision, and a cyclical variation of apparent brightness is reported. As indexes of such an effect, both the frequency of the fluctuation and the LDR ratio (that is, the ratio of the time through which the field is seen as bright to the time through which it is seen as dark), are assumed. During the training period of an unexperienced subject, the frequency of the fluctuation is found to increase (starting from zero value on), while the LDR tends to decrease. No significant differences are tested between the LDR for the right eye and that for the left eye, if the fixation point lies at the center of the 10° field. But, if the fixation is brought at one extreme of the horizontal diameter, different LDR are recorded, within one of the eyes, according to the half retina (either right or left) stimulated. When the 10° field is fixated, in binocular vision, the apparent brightness is seen to fluctuate, but the total black-out is never reported. A small contrast difference is perceived only for a fraction of the time of presentation. The amount of the decrease in brightness, during the course of fluctuation, might be evaluated once assumed that a decrease in apparent brightness involves a decrease in liminal contrast (by analogy with Fechner's law concerning the variation of contrast threshold as a function of adapting luminances).

1335

Istituto Nazionale di Ottica, Florence (Italy).

ADAPTATIONAL EFFECTS AT PHOTOPIC AND

MESOPIC LUMINANCES AS A FUNCTION OF CONTRAST, by L. Ronchi and A. M. Ercoles. [1962] [12]p. incl. diagrs. refs. (AFOSR-4196) (AF EOAR-61-34) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 185-196, Mar. Apr. 1962.

The eye is first presented with a bipartite field, consisting of 2 adjacent fields of different luminances, the relative contrast being c; after a given adaptation time T, the eye is presented with a field of uniform luminance upon which, if steady fixation is maintained, a difference of brightness is seen to persist for a given time t. For given values of both T and c, the behavior of t as a function of log luminance has been recorded; t is found to vary from a few seconds to, say, 150 sec. For low values of c, the difference of brightness appears appears after a latency time of a few seconds. Last, the transition between the 2 zones of different brightness appears as delimitated by a dark band. In addition to such a slow effect, a rapid bright band is seen to appear for a brief time after the onset of the gradient of brightness. The likelihood of perceiving such a band, as determined by collecting the responses recorded in a number of successive presentations, is found to be good at photopic levels, if contrast exceeds, say, 0.50; for lower contrast the perception of the band is counteracted by the above reported slow effect. From a theoretical stand point, the attempt is made to correlate both the bright and the dark bands due to a difference of brightness with the bright and the dark Mach bands due to a difference of luminance; in other words, a tentative explanation of Mach phenomenon in terms of adaptational effects is suggested.

1336

Istituto Nazionale di Ottica, Florence (Italy).

ON THE SHARPNESS OF DEFOCUSSED CONTOURS, by L. Ronchi and I. Adachi. [1962] [7]p. incl. diagrs. table. (AFOSR-4197) (AF EOAR-61-34) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 405-411, July-Aug. 1962.

A step of luminance is brought out of focus and the threshold of disappearance of the Mach bands, delimitating the graded zone between the 2 plateaus, is determined. This depth of focus (pupil diam 2.5 mm) is found to be of the order of 3.5 dt, and, in addition, it is found to increase when contrast is increased. By adopting a quite different criterion, but with about the same pupil (3 mm) Campbell finds that his depth of focus (of about 0.4 dt) decreases when contrast is increased. This contradiction, however, is only partial, in that, in both the experiments, the slope of the spatial gradient of luminance, at the retina, needed for reporting a sharp vision, is the lower the lesser the contrast difference is. The results are discussed in terms of local adaptation mechanisms.

1337

Istituto Nazionale di Ottica, Florence (Italy).

ADAPTATION AND TRAINING EFFECTS IN ERG: I LONGTERM ADAPTATION, by S. J. Freedman and L. Ronchi. [1962] [6]p. incl. diagrs. (AFOSR-4198) (In cooperation with Massachusetts Mental Health Center, Boston) [AF EOAR-61-34] Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 381-386, July-Aug. 1962.

For abstract see item no. 1904, Vol. VI.

1338

Istituto Nazionale di Ottica, Florence (Italy).

SUBJECTIVE SHARPNESS AND CONTRAST THRESHOLD, by M. Bittini. [1962] [9]p. incl. diagrs. refs. (AFOSR-4199) (AF EOAR-61-34) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 387-395, July-Aug. 1962.

The threshold of visibility and of subjective sharpness of objectively sharp contoured targets have been determined at various luminance levels. Subjective sharpness threshold relative to corresponding contrast threshold is constant at photopic levels, while, in the range of scotopic luminances, it increases with decreasing luminance.

1339

Istituto Nazionale di Ottica, Florence (Italy).

ON THE VARIABILITY OF THE RATES OF RISE AND DECAY OF THE SCOTOPIC B-WAVE, by A. M. Ercoles and E. Masci. [1962] [4]p. incl. illus. diagrs. (AFOSR-4204) (AF EOAR-61-34) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 362-365, July-Aug. 1962.

Typical electroretinographic responses were examined under the following experimental conditions: Maxwellian view, focal area 3°, exposition time = 40 msec. It is shown that the standard deviation of the scotopic b-wave is of the same order of magnitude for both the mean rate of rise and of decay, respectively. It is concluded that when a long time constant (0.8 sec) is used, the ERG response as a whole may give indications about the component of adaptation to light of the scoptopic retina.

1340

Istituto Nazionale di Ottica, Florence (Italy).

MEMORY FOR BRIGHTNESS: STIMULI OF SMALL SIZE, SURROUNDED BY DARK, by M. Conticelli.

[1962] [10]p. [Series no. 4; rept. no. 386] (AFOSR-J203) [AF EOAR-61-34] AD 400064 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 497-506, Sept.-Oct. 1962.

Two stimuli, of different luminances (both mesopic), in a dark room were delivered to the central retina either contemporaneously or in succession. Subjects are instructed to express their judgement about the relative difference of brightnesses. In the first part of the experiment, the luminance of the former stimulus differed with respect to that of the latter by 0.1 log units; in the second part, 0.2 log units. In the latter case, the number of wrong responses was found to increase rapidly when passing from the simultaneous match to the memory match, corresponding to a time interval of 8 sec. If such an interval is increased from 8 sec to 60 sec, a slow increase in the number of wrong responses is found. Once accepted that an adaptational process affecting the trace left by the former stimulus is at work, the time constant of such a process can be evaluated.

1341

Istituto Nazionale di Ottica, Florence (Italy)

VISUAL EFFECTS PRODUCED BY A STIMULUS CONSISTING OF A NUMBER OF BLACK LINE SEGMENTS VIEWED ON A BRIGHT BACKGROUND, by L. Ronchi and G. Bottai. [1962] [16]p. [Series no. 2; rept. no. 997] (AFOSR-J204) [AF EOAR-61-34] AD 400446 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 507-522, Sept.-Oct. 1962.

The brightness enchancements and depressions occurring when filling in a blank bright sheet with a variable number of black straight line segments, all parallel and lying in a fronto-parallel plane, are reported; the measurement of the observed effects is performed by a method based on the determination of the threshold of flicker relative to a small exploring spot. In addition, by bending a thin straight line segment to a greater or lesser extent, various configuratica are created and a method for classifying the various letters of the alphabet is suggested. The results are discussed in terms of the current theories of retinal interactions.

1342

Istituto Nazionale di Ottica, Florence (Italy).

A COMPARISON BETWEEN FOVEAL AND PERIPHERAL FLICKER SENSITIVITY FOR COLORED LIGHTS, AT PHOTOPIC LEVELS, by M. Bittini. [1962] [5]p. incl. diagrs. (AFOSR-J233) (AF EOAR-61-34) AD 400850 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 623-627, Nov.-Dec. 1962.

Classical findings are confirmed as far as red, green and white lights are concerned, in that sensitivity to flicker is once more tested to be greater for the fovea than for the periphery at high luminance levels. A peculiar effect is tested in the case of blue light, in that the maximum sensitivity is tested at 15° to 20° of eccentricity at both lower frequencies (up to 15 to 18 cps) and higher frequencies (greater than 30 cps). In the intermediate range, foveal sensitivity to flicker is found to be greater than peripheral sensitivity. Results are discussed. As a practical implication, the narrowing of the visual field at high speeds of driving is taken into account. (Contractor's abstract)

1343

Istituto Nazionale di Ottica, Florence (Italy).

QUANTITATIVE ASPECTS OF THE BLUR-TO-SHARP TRANSITION, by L. Ronchi. [1962] [25]p. incl. diagrs. table, refs. (AFOSR-J234) (AF EOAR-61-34) AD 400868 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 646-670, Nov.-Dec. 1962.

The effects produced by a graded distribution of luminance delimitated by 2 uniform fields of different luminances are discussed, on the basis of experimental data produced by a number of authors. The main finding is that the slope of the graded zone, at the threshold of visibility of the bright Mach band, increases when the difference between the luminances of the 2 uniform fields is increased. Thus, one cannot speak of limiting slope in an absolute sense. It is considered that the early distinction between border and surface contrast is abolished and it is assumed that sensation of sharpness, Mach phenomenon and simultaneous contrast effect might by subserved by the same mechanism. An attempt is made to explaining the reported results in terms of rapid local adaptation. Such an effect seems to play the major role when the width of the penumbra is lesser than, say, 24'. For larger penumbrae (up to about 5°), the Mach phenomenon ceases to appear sharp or vivid. The perception of sharpness in the case of a thin stripe is discussed, and some problems connected with the visual resolving power, as determined by the aid of a grating, are emphasized. (Contractor's abstract)

1344

Istituto Nazionale di Ottica, Florence (Italy).

RED AND BLUE ELECTRORETINOGRAMS AT VARIOUS LUMINANCES, by A. M. Ercoles. [1962] [10]p. incl. diagrs. table. (AFOSR-J235) (AF EOAR-61-34) AD 400867 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 628-637, Nov.-Dec. 1962.

Electroretinographic intensity functions are recorded from a dark-adapted eye stimulated by 2 beams: one red, the other blue with variable relative angular extents. The comparison of these curves with those obtained by a red stimulus or by a blue stimulus, shows that the simultaneous presentation of 2 stimuli far apart in the spectrum produces a complex electroretinographic response and evokes a series of inhibition and facilitation effects.

1345

Istituto Nazionale di Ottica, Florence (Italy).

VISIBILITY OF A STEADILY FIXATED OR STABILIZED TEST OBJECT AS A FUNCTION OF EXCENTRICITY, by A. M. Ercoles and A. Fiorentini. [1962] [8]p. incl. diagrs. table. (AFOSR-J236) (AF EOAR-61-34) AD 400870 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 638-645, Nov.-Dec. 1962.

A narrow black line on a bright background intermittently disappears when the subject tries to keep his eye steady by voluntary fixation or when the effects of both voluntary and involuntary eye movements are prevented (stabilized retinal images). The time of visibility of the line as a fraction of the total observation time was measured for various retinal eccentricities of the line, from 6 to 150 min arc. The total time of visibility is found to decrease with increasing eccentricity both with voluntary fixation and with stabilized image. This result can be probably ascribed to 2 facts. First, in the total constraint of movement, the visibility of a detail decays more rapidly in the parafovea than in the fovea. Second, the change in retinal stimulation produced by a movement of a given amplitude is more effective in maintaining the visibility of the detail when this is imaged in the fovea than in the parafovea.

1346

Istituto Nazionale di Ottica, Florence (Italy).

CERENKOV RADIATION IN A LAYERED MEDIUM, (Abstract), by L. Ronchi and G. T. di Francia. [1962] [1]p. [AF EOAR-61-34] Unclassified

Presented at annual meeting of the Opt. Soc. Amer., Rochester, N. Y. [1962].

Published in Jour. Opt. Soc. Amer., v. 52: 1315, Nov. 1962.

The medium considered consists of a set of equispaced metal films, imbedded in a dielectric whose refractive index is such that the velocity of the charged particle is above threshold for Čerenkov radiation. The first and last films are in contact with vacuum. The radiated field results from a complicated combination of transition radiation and Čerenkov radiation. Due to the finite size of the system in the direction of the particle velocity, diffraction also must be taken into account. However, it is possible to give the solution in a finite form for any number of films. Some computations have been performed in order to plot the gain over pure Čerenkov radiation for a number of values of the several parameters.

1347

John Carroll U. [Dept. of Physics] Cleveland, Ohio.

SINGLE-CRYSTAL ELASTIC CONSTANTS OF POTASSIUM (Abstract), by W. Marquardt, J. Trivisonno, and T. Klucher. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-224] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 548, Nov. 23, 1962.

The single-crystal elastic constants of potassium have been measured as a function of temperature by the ultrasonic pulse-echo technique. The crystals were grown in air by a modified Bridgman technique. A discussion of the growth process and the preparation of the acoustic specimens is presented. The values of the measured stiffness constants at 195°K are $(C_{11} + C_{12} + 2C_{44})/2 = 0.527$, $C_{44} = 0.207$, and $(C_{11}-C_{12})/2 = 0.032$ in units of 10^{11} dyn/cm^2. The bulk modulus computed from the measured stiffness has the value of 0.31×10 dyn/cm^2.

1348

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

THE ISOTROPIC-EXCHANGE REACTIONS OF B_2H_6 WITH DT, HT, AND HD, by J. S. Rigden and W. S. Koski. [1961] [10]p. incl. diagrs. table. (Technical note no. 16) (AFOSR-1633) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)-1526 and Atomic Energy Commission) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3037-3040, July 20, 1961.

For abstract see item no. 1219, Vol. V.

1349

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

NEW MICROCATALYTIC CHROMATOGRAPHIC TECHNIQUE FOR STUDYING CATALYTIC REACTIONS AND CATALYTIC ACTIVITY OF METALS, by P. H. Emmett. Final rept. Aug. 15, 1957 - Oct. 15, 1962 [158]p. incl. illus. diagrs. tables, refs. (AFOSR-4949) (AF 18(603)129) AD 414022 Unclassified

The aim of this project is to obtain new basic knowledge and ideas relative to the mechanism of catalytic reactions and the factors important in the activity of catalysts. Topics discussed are: (1) the use of the new microcatalytic chromatographic technique for studying catalytic reactions; (2) the catalytic hydrogenating activity of nickel, copper and nickel-copper alloys; (3) the nature of the hydrogen content of Raney Nickel hydrogenating catalysts; and (4) late studies on the chemisorption of hydrogen and nitrogen on iron synthetic ammonia catalysis.

1350

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

FAR INFRARED SPECTRA OF FREE RADICALS AND REACTIVE MOLECULES AT 4°K, by D. W. Robinson. Final rept. Sept. 15, 1962 [9]p. incl. table, refs. (AFOSR-3613) (AF 49(638)468) Unclassified

The absorption spectra of several symmetric-top molecules, $(CH_3CN$, $H_3CC{\equiv}CH$, $(CH_3)_3N$, and F_3CH have been investigated. From this study, it was possible to estimate a previously undetermined centrifugal distortion constant, $D_J = 1.45 \pm 0.3 \times 10^{-7}$ cm for methyl cyanide. Crystals of benzene, chloroform, carbon dioxide, nitrogen dioxide, and iodoform were analyzed. Chloroform, iodoform, and nitrogen dioxide absorbed between 70 and 30 cm^{-1}, but no features sharp enough to measure were seen. Benzene and carbon dioxide crystals were transparent. Hydrogen chloride and hydrogen deuteride have also been studied, a band has been found at 87 cm^{-1} which does not shift appreciably when the hydrogen is replaced by deuterium. At long wavelength, acetaldehyde was found to give a spectrum like that expected of a symmetric top. Other molecules tested included F_5CSF_5, disiloxane, and $H_3C\text{-}C{\equiv}C\text{-}SiH_3$.

1351

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

INFRARED SPECTRUM OF METHYLSILYLACETYLENE, by D. W. Robinson and R. B. Reeves. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-J1) (AF 49-(638)468) AD 400395 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2625-2630, Dec. 1, 1962.

The compound methylsilylacetylene has been prepared for the first time and its vibrational spectrum has been obtained and assigned. All but 2 of the fundamentals have been identified. The rotational Q branches of the perpendicular bands have been resolved for the 3 group modes of SiH_3, and a comparison of the Coriolis coupling constants with those of other silyl-containing molecules indicates a low or vanishing barrier to internal rotation. The relative intensities of the Q branches further supports this observation. (Contractor's abstract)

1352

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

THE EXISTENCE OF LARGE OR SMALL SOLUTIONS OF LINEAR DIFFERENTIAL EQUATIONS, by P. Hartman. [1960] [9]p. (AFOSR-3835) (AF 49(638)970) Unclassified

Also published in Duke Math. Jour., v. 28: 421-429, Sept. 1961.

For abstract see item no. 1031, Vol. IV.

1353

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ON DICHOTOMIES FOR SOLUTIONS OF N-TH ORDER LINEAR DIFFERENTIAL EQUATIONS, by P. Hartman. [1962] [4]p. incl. refs. (AFOSR-3836) (AF 49(638)-970) Unclassified

Also published in Math. Ann., v. 147: 378-421, 1962.

Much of the general theory (Part I) is a transcription of some of the results of Massera and Schäffer from a first order differential operator to a more general operator. The results of Parts II (higher order differential equations) and III (second order differential equations) are deduced from Part I. An appendix deals with a real scalar, second order linear equation. It is shown that the methods used in Part III give oscillation and non-oscillation theorems and a new criterion for Weyl's limit-point case.

1354

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ON UNBOUNDED TOEPLITZ MATRICES, by P. Hartman. [1962] [20]p. incl. refs. (AFOSR-J1525) (AF AFOSR-62-45) AD 427525 Unclassified

Also published in Amer. Jour. Math., v. 85: 59-78, Jan. 1963.

Let $g(\varphi)$ be a real-valued function in L^2 $(0, 2\pi)$ with Fourier series $\Sigma_{-\infty}^{\infty} g_n e^{in\varphi}$, and let $T(g) = (g_{n-m})$, $n, m = 0, 1, \ldots$, be the associated, formally Hermitian Toeplitz matrix. $T(g)$ is regarded as a transformation in L^{2+}, the space of functions in L^2 whose negative Fourier coefficients vanish. Finding necessary and sufficient conditions on g that $T(g)$ be self-adjoint is equivalent to the solution of a closure problem. If f is in L^2 let $M(f)$ be the closed span of $f e^{in\varphi}$, $n = 0, 1, \ldots$, and let $N(f)$ be the closure of the projection of $M(f)$ onto L^{2+}. Then $T(g)$ is self-adjoint if and only if $N(g \pm i) = L^{2+}$. Sufficient conditions on f for $N(f) = L^{2+}$ lead to conditions on g that $T(g)$ be self-adjoint. For example, $T(g)$ is self-adjoint if there is a determination $\theta(\varphi) = \arctan 1/g(\varphi)$ having a conjugate function $\psi(\varphi)$ such that $\exp(|\psi(\varphi)| - (1 + |g(\varphi)|))$ is in L^1. (Math. Rev. abstract)

1355

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ON THE LOCAL LINEARIZATION OF DIFFERENTIAL EQUATIONS, by P. Hartman. [1962] [8]p. (AFOSR-J1527) (AF AFOSR-62-45) AD 426515 Unclassified

Also published in Proc. Amer. Soc., v. 14: 568-573, Aug. 1963.

Consider the autonomous system of real differential equations (1) $x' = Ex + F(x)$, where x is an n-vector, E a constant matrix and the perturbation $F(x) = 0(|x|)$ as $x \to 0$. The following result is proved in the paper. If $F(x)$ in (1) is of class C^1 for small $|x|$ (or uniformly Lipschitz continuous with a Lipschitz constant for $|x| \leq \epsilon$ which tends to zero as $\epsilon \to 0$) and each eigenvalue of E has real part different from zero, then there exists a topological map $R; u = u(x)$ of a neighborhood of $x = 0$ onto a neighborhood of $u = 0$ such that solutions of (1) are mapped onto solutions of the linear system $u' = Eu$. The analogue of this result was proved previously by the author under the assumption that F is of class C^2. (Math. Rev. abstract)

1356

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ON UNIQUENESS AND DIFFERENTIABILITY OF SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS, by P. Hartman. [1962] [14]p. incl. refs. (AFOSR-J1528) (AF AFOSR-62-45) AD 427514 Unclassified

Also published in Nonlinear Problems; Proc. of a Symposium, Wisconsin U., Madison (Apr. 30-May 2, 1962), ed. by R. E. Langer, Madison, Wisconsin U. Press, 1963, p. 219-232.

The object of this note is to obtain generalizations of the uniqueness theorems given in a previous paper (see item no. JHU. 09:006, Vol. II) and to give a new, simple proof of the main results presented in the earlier report. The proofs will depend on approximating f suitably and using a priori estimates. The proof is based in part on inequalities related to those of D. C. Lewis, particular cases of which have recently been used to obtain results on stability in the large.

1357

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS, by C. V. Coffman. [1962] [30]p. incl. refs. (AFOSR-64-1588) (AF AFOSR-62-45) AD 446449 Unclassified

Also published in Trans. Amer. Math. Soc., v. 110: 22-51, Jan. 1964.

This paper is concerned with the asymptotic behavior of solutions of ordinary difference equations with almost constant coefficients, i.e., equations having the form $y(n + 1) = Jy(n) + f(n, y(n))$, where y is a d-vector, J is

a constant d x d matrix and f(n, y) is a vector-valued function which is continuous in y for fixed n and becomes small in some sense as (n, y) → (∞, 0).

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Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ON THE ASYMPTOTIC INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS, by P. Hartman and N. Onuchic. [1962] [15]p. (AFOSR-64-1608) (AF AFOSR-62-45) AD 445894 Unclassified

Also published in Pacific Jour. Math., v. 13: 1193-1207, 1963.

Various methods have been employed for the asymptotic integration of ordinary differential equations, e.g., successive approximations, topological arguments involving Wazewski's or similar principles, and fixed points theorems. The object of this note is to illustrate the application for this purpose of a simple and general theorem which is based, on the one hand, on Massera and Schäffer's use of the open mapping theorem, and, on the other hand, on Tychonoff's fixed point theorem. This general theorem is essentially a corrected version of Corduneanu.

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Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

A SWIRLING ROUND TURBULENT JET. I. MEAN-FLOW MEASUREMENTS, by W. G. Rose. [1962] [11]p. incl. illus. diagrs. refs. (AFOSR-1516) (AF 49(638)-248) AD 406817 Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Engineers, New York, Nov. 25-30, 1962.

Also published in Jour. Appl. Mech., v. 29: 615-625, Dec. 1962.

A swirling jet of air is generated for this work by flow issuing from a rotating pipe into a reservoir of motionless air. At the pipe discharge, the flow is roughly a fully developed, turbulent pipe flow in solid-body rotation. Owing to the very rapid decay of the swirl, measurements are confined to a region extending from the pipe discharge out to a distance of 15 pipe diameters. Mean-velocity magnitudes and mean directions are the primary results; in addition, one turbulence intensity component is included. All velocities and intensities were measured with a constant-temperature hot-wire anemometer having a linearized response, and all mean values were determined by electronic integration. Contrasted with the nonswirling jet, the jet with swirl spreads at a larger angle, entrains reservoir fluid more rapidly, and consequently displays a more rapid reduction of mean-velocity and growth of turbulence intensity. In its gross features, at large distances from the orifice, the measured swirling jet agrees with the predictions of "weak-swirl" analyses. (Contractor's abstract)

1360

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

MEASUREMENTS IN A TWO-DIMENSIONAL TURBULENT JET, by G. Heskestad. Apr. 1962 [19]p. incl. diagrs. (AFOSR-2456) (AF 49(638)248) AD 281065 Unclassified

Preliminary results of measurements on a 2-dimensional turbulent jet are reported. The measurements were made with a constant temperature hot-wire set in a region far enough downstream to be approximately self-preserving. The results include the lateral distribution of mean streamwise velocity, together with rms components fluctuating velocities and Reynolds shear perpendicular to them. The results are preliminary to the extent of needing corrections for non-linear effects of the hot-wire. (Contractor's abstract)

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Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

GENERATION OF A "STRONGLY" SWIRLING JET AND PRELIMINARY EXPERIMENTS ON THE EFFECT ON ITS DEVELOPMENT OF INITIAL SWIRL DISTRIBUTION, by W. G. Rose. June 1962 [27]p. incl. illus. diagrs. table. (AFOSR-2552) (AF 49(638)248) AD 292300 Unclassified

A description is given of a device designed to generate a strongly swirling turbulent jet with an initial swirl distribution which is roughly a vortex with a core in solid body rotation. Experimental results are reported of measurements taken at the discharge of the unit (the jet origin) and along the axis of the jet issuing from it. All measurements were taken on the jet axis and include mean-velocities, axial turbulence intensity components, and mean static-pressure distributions. Based on the results, the device, or swirl generator, performs successfully. Although no radial distributions were measured, the classification strong swirl is justified in part by the magnitude of static-pressure differences generated between ambient conditions and those on the jet axis at its origin, and in part by the low values of Rossby number that are established. The experiments on the effect of initial swirl distribution demonstrate the need for a more extensive and systematic investigation to separate swirl effects from Reynolds number effects. It should be possible to establish the range of Reynolds numbers and swirl strengths required with the swirl generator as it is presently constructed. (Contractor's abstract)

1362

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

CORRECTIONS TO AVERAGE MEASUREMENTS IN UNSTEADY FLOW, by W. G. Rose. [1962] [5]p. incl. diagrs. [AF 49(638)248] Unclassified

Published in Symposium on Measurement in Unsteady Flow, Worchester, Mass. (May 21-23, 1962) New York, Amer. Soc. of Mech. Engineers, 1962, p. 85-89.

Results of 2 derivations are presented: (1) the linearized response of a constant-temperature hot-wire anemometer, and (2) the relationship between mean-flow direction and mean direction of flow. The response equation includes the effects of variations in fluid temperature and flow direction. Corrected equations for outputs in terms of mean velocity, turbulence intensity, and shear stress are also presented. The relationship obtained for the 2 directions gives their difference proportional to a velocity correlation, and is correct to within the second order in the velocity fluctuations. (Contractor's abstract)

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Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

EXPERIMENTAL STUDY OF DYNAMIC PLASTICITY AT ELEVATED TEMPERATURES, by J. F. Bell. [1961] [7]p. incl. illus. diagrs. refs. [AF 49(638)423] Unclassified

Presented at Spring meeting of the Soc. for Experimental Stress Analysis, Philadelphia, Pa., May 10-12, 1961.

Published in Exper. Mech., v. 2: 181-186, June 1962.

It is shown that the diffraction-grating technique and the optical-displacement used for the study of plastic wave propagation at room temperature, may both be extended to within 100° F of the melting point of aluminum. In addition to the measurement of stress history at the impact face obtained by the extension of the load-bar technique to elevated temperatures, strain-time, surface angle-time, time of contact, coefficient of restitution, and displacement-time behavior at the free end of the struck specimen may all be determined at elevated temperatures. Typical strain-time behavior is shown at 800°, 1000°, and 1100° F, for 2 types of impact situations. (Contractor's abstract)

1364

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

APPLICABILITY OF THE TAYLOR THEORY OF THE POLYCRYSTALLINE AGGREGATE TO FINITE AMPLITUDE WAVE PROPAGATION IN ANNEALED COPPER, by J. F. Bell and W. M. Werner. [1962] [10]p. incl. diagrs. table, refs. [AF 49(638)423] Unclassified

Published in Jour. Appl. Phys., v. 33: 2416-2425, Aug. 1962.

This paper provides additional experimental evidence for the Taylor theory of dislocations and the Taylor theory of the polycrystalline aggregate. For annealed copper the governing stress-strain curve for plastic wave propagation is a parabola, as predicted by the Taylor theory of dislocations. Using the Taylor theory of the polycrystalline aggregate, the parabolic stress-strain law for annealed copper is determinable from compression stress-strain curves for single crystals. These experimental data in annealed copper are obtained from the free-flight constant-velocity impact of identical specimens using the diffraction-grating technique for the measurement of strain and surface angle. From the results given in this paper, together with those obtained earlier by Bell for annealed aluminum and the recent results of Sperrazza for pure lead, it may be concluded that strain rate does not play a significant role in the dynamic plasticity of these annealed face-centered-cubic metals. As in annealed aluminum and pure lead, plastic strain propagation velocities, maximum strain amplitude, surface angle behavior, time of contact, and the coefficient of restitution for annealed polycrystalline copper are found to be given by the strain-rate independent theory of plastic wave propagation. (Contractor's abstract)

1365

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

CONCEPT OF FIELD MODES AND THE BEHAVIOR OF THE MAGNETOHYDRODYNAMIC FIELD, by F. H. Clauser. [1962] [23]p. incl. diagrs. tables, refs. (AFOSR-J764) (AF 49(638)496) AD 414028; AD 409962 Unclassified

Also published in Phys. Fluids, v. 6: 231-253, Feb. 1963.

A method for studying the behavior of fields by splitting their behavior into independent field modes is presented. The method is used to explore the characteristics of steady, 2-dimensional, linearized magnetohydrodynamic fields with finite viscosity and resistivity and arbitrary orientation of the magnetic vector relative to the velocity vector. It is shown that in general boundary layers and wakes cease to exist in magnetohydrodynamics. Their place is taken by diffusing waves which, in reality, are the fields of a set of viscous-resistive sources, vortices, poles and currents whose field lines are strongly oriented along the characteristic wave directions. When the viscosity and resistivity are equal, these waves diffuse in a simple and independent way, but when these quantities are not equal, the diffusing waves generate a new kind of wake which is located, veil-like, in the fan-shaped region between the 2 wave directions. These wakes are fed from the differential diffusion of the primary waves. In the special case for which the resistivity is much greater than the viscosity, a new type of pseudo boundary layer is shown to exist in the velocity field. When the viscosity is much greater than the resistivity, this pseudo boundary layer occurs in the magnetic field. (Contractor's abstract)

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Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

LIQUID FLOW IN TUBES. VIII. INFLUENCE OF ROUGHNESS UPON THE TRANSITION PROCESS, by E. R. Lindgren. [1962] [15]p. incl. diagrs. refs. (AFOSR-J766) (AF 49(638)496) AD 413373 Unclassified

Also published in Arkiv Fysik, v. 24: 269-283, 1963.

Recently, report was made on experiments indicating

that uniform, close packed wall roughness elements of the sand type do not seem to influence the mechanism of breakdown ("spike" formation) in steady pipe flow. The present study on the other hand indicates a strong influence by the same wall roughness upon the transition process that follows, once breakdown has taken place. The relative propagation velocity of the rear of the turbulent slugs or streaks, appears to decrease monotonically with increasing roughness, even when the roughness grains are an order of magnitude smaller than the estimated thickness of the viscous sublayer in the turbulent slugs or streaks. The relative front velocity, of the same slugs or streaks also appears to be sensitive to variations of wall roughness within the same flow regions, though in a non-monotonic manner. This is in agreement with a previous report on change due to variations of microscopic wall roughness in cylindrical pipes. (Contractor's abstract)

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Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

LIQUID FLOW IN TUBES. VII. MOMENTUM PERTURBATION AND BREAKDOWN OF STEADY FLOW IN RELATION TO WALL ROUGHNESS, by E. R. Lindgren. [1962] [7]p. incl. diagr. (AFOSR-64-0859) (AF 49(638)496) AD 438597 Unclassified

Also published in Arkiv Fysik, v. 23: 403-409, 1963.

Experiments show that breakdown of laminar pipe flow is not uniquely correlated to the amount of disturbance momentum imposed on the flow within the refinement of the present experimental technique, nor does the breakdown in any way seem to be dependent on the surface properties of the tube walls in the case of closely packed, evenly distributed roughness elements even when they are rather large. The breakdown of the flow is related apparently to some kind of disturbance magnitude, though its appropriate measure is not clear. The breakdown is found to occur as a violent spike formation far away from the walls, in agreement with findings on boundary layer breakdown. The spikes may or may not cause the development of turbulent slugs, which in turn may or may not be self-maintaining in the lower transition Reynolds number region. (Contractor's abstract)

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Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

DESLIP IN ALUMINUM SINGLE CRYSTAL SPECIMENS, by R. B. Pond and E. Harrison. Final rept. Jan. 1962 [40]p. incl. diagrs. tables. (AFOSR-2304) (AF 49-(638)509) AD 274107 Unclassified

By the technique of interferometric cinemicrography, deslip in Al single crystals was observed as a result of reversing the stress. An explanation of the phenomenon is presented. The technique is also used to evaluate the effects of temperature over the range -250° to +225°F, on the velocity of slip. Unslip of a band during continuing deformation was observed. The deslip phenomenon is not dependent on time, extent of strain, or orientation, but may be dependent on lattice bending. The velocity of slip between -150° and 225° is relatively unaffected by the mechanical property changes, but is primarily dependent on the frequency of co-active slip bands. Unslip is explained by lattice bending of the elastic type.

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Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

THE DYNAMIC OVERSTRESS AND THE HYDRODYNAMIC TRANSITION VELOCITY IN THE SYMMETRICAL FREE FLIGHT PLASTIC IMPACT OF ANNEALED ALUMINUM, by J. F. Bell and J. H. Suckling. [1962] [7]p. incl. diagrs. refs. (AFOSR-5299) (AF 49(638)-1067) 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. 2: 877-883, 1962.

The dynamic overstress and the initial peak stress are determined in dead annealed aluminum for a symmetrical, free flight impact without the introduction of hard elastic load bars, piezo crystals, etc. By determining the time of contact for specimens of varying length, the stress-time history at the impact face is found to be consistent with the theoretical and experimental correlations of J. F. Bell. The transition velocity between plastic and hydrodynamic regimes, suggested 49 years ago by B. Hopkinson and more recently by H. G. Hopkins and H. Kolsky, is experimentally identified. The initial peak stress and the dynamic overstress decrease in time to the maximum of the parabolic stress-strain law in a manner consistent with the strain rate independent interpretation.

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Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

SINGLE, TEMPERATURE-DEPENDENT STRESS-STRAIN LAW FOR THE DYNAMIC PLASTIC DEFORMATION OF ANNEALED FACE-CENTERED CUBIC METALS, by J. F. Bell. [1962] [8]p. incl. diagrs. refs. (AFOSR-64-1031) (AF 49(638)1067) AD 440985 Unclassified

Also published in Jour. Appl. Phys., v. 34: 134-141, Jan. 1963.

Large amplitude wave propagation in annealed aluminum is studied experimentally to within 70°C of the melting point of the metal. The strain-rate-independent, finite amplitude wave theory is found to apply at all temperatures. The governing stress-strain law in each instance is parabolic. The coefficient of the parabolic stress-strain law varies linearly with the absolute temperature. The annealed, face-centered cubic metals of aluminum, copper, lead, gold, and silver are all found to have the same parabolic stress-strain law at absolute zero. Thus, from experiments using the author's diffraction grating

technique, a single stress-strain law is found which is applicable at any temperature to any of these annealed metals whose melting point is specified. (Contractor's abstract)

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Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

COUPLED THERMOPLASTICITY, by O. W. Dillon, Jr. [1962] [13]p. incl. diagrs. (AFOSR-4480) (AF AFOSR-62-204) Unclassified

Also published in Jour. Mech. and Phys. Solids, v. 11: 21-33, Jan.-Feb. 1963.

Experimental stress, strain and temperature histories are reported for annealed aluminum tubes undergoing torsional oscillations. These data show that heat is generated when aluminum responds as a non-linear material. It is necessary, therefore to consider the coupling between the thermal and mechanical fields. A derivation of the coupled heat-conduction equation, with the rate of doing plastic work as a source term, is also presented. This equation is a generalization of the experimental results. It has an advantage over isothermal plasticity, in that conservation of energy is considered. (Contractor's abstract)

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Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

TEMPERATURE GENERATED IN ALUMINUM RODS UNDERGOING TORSIONAL OSCILLATIONS, by O. W. Dillon, Jr. [1962] [6]p. incl. illus. diagrs. (AFOSR-J54) [AF AFOSR-62-204] AD 400391 Unclassified

Also published in Jour. Appl. Phys., v. 33: 3100-3105, Oct. 1962.

Experimental data on the heat generated during torsional oscillations of annealed aluminum rods are presented. These results demonstrate the necessity of including coupling between the temperature field and the deviatoric components of strain when the material is deformed beyond the linear elastic region. The experiments are of sufficient duration that an approximate balance of the heat generation and the losses by conduction is finally reached. Temperatures in excess of 500°F are observed. It is also found that heat is generated during the loading parts of the cycle but that none is created when the material is unloading. (Contractor's abstract)

1373

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

COUPLED THERMOPLASTICITY, by O. W. Dillon, Jr. [1962] [13]p. incl. diagrs. (AFOSR-J1220) (AF AFOSR-62-204) Unclassified

Also published in Jour. Mech. and Phys. Solids, v. 11: 21-33, Jan.-Feb. 1963.

For abstract see Item no. 1371, Vol. VI.

1374

Johns Hopkins U. [Dept. of Medicine] Baltimore, Md.

THE GOITROGENIC ACTIVITY OF PEROXIDASE, by J. P. Isaacs, J. C. Lamb and others. [1962] [1]p. (AFOSR-3443) (AF 49(638)580) AD 612455 Unclassified

Also published in Bull. Johns Hopkins Hosp., v. 110: 232, 1962.

Peroxidase was administered to rabbits in oral dosages of 1-2 mg/kg body weight per day. The peroxidase has been fed in form of cabbage, horseradish root, water extract of horse-radish root, and lyophilized horseradish peroxidase. Each of these has caused (a) follicular epithelial hyperplasia in the thyroid and (b) graded increases in thyroid weight with graded increases in dosage of peroxidase. It has been possible to measure spectrophotometrically a several fold increase in peroxidase activity in the thyroid glands of animals fed the above materials. Peroxidase levels in the blood of these animals is also increased. By way of control observations, 1-5 vinylthiomazolidone, n-propylthiouracil, etc. inhibit peroxidase activity in vivo and in vitro. The lyophilized peroxidase when heated to cause denaturation does not exert a goitrogenic effect. 1-5 vinylthiomazolidone is poorly soluble in water, yet the water extract of horse-radish containing peroxidase in dosages of 2 mg/kg day is very goitrogenic, producing a 50% increase in thyroid weight in 14 days. Intravenous peroxidase in 1/100th the oral dosages (0.02 mg/kg/day) causes goiters and increases thyroid peroxidase activity. For the present, the observation is advanced that oral exogenous peroxidase is goitrogenic. Additional studies are being pursued with the object of linking more definitely the intrathyroidal mechanism of goitrogenesis with the thyroid peroxidase.

1375

Johns Hopkins U. [Dept. of Medicine] Baltimore, Md.

STRIATE CORTEX CONNECTIONS IN THE MONKEY (Abstract), by R. E. Myers. [1962] [1]p. (AFOSR-66-1116) (AF AFOSR-61-38) AD 640671 Unclassified

Presented at Forty-sixth annual meeting of the Federation of American Societies for Experimental Biology, Atlantic City, N. J., Apr. 14-18, 1962.

Also published in Federation Proc., v. 21: 352, Mar.-Apr. 1962.

Patterns of degeneration were studied in monkeys after removal of small extents of the striate cortex. The Nauta-Gygax technique demonstrated degenerating fibers streaming from the lesion areas through the white matter to distribute densely in cortex of neighboring sectors of area 19. Either no fibers or extremely few fibers

were found to pass into intervening area 18. Within area 17 itself degenerating fibers were found only in immediate relation to the lesions usually coursing horizontally within the granular layers without passing through the white matter. No degenerating fibers entered the corpus callosum nor did any distribute in the opposite hemisphere. Other contingents of fibers passed toward the brainstem to end in circumscribed areas of the lateral geniculate nucleus, the suprageniculate nucleus and the inferior and lateral subdivisions of the pulvinar. Other fibers coursed through the thalamus to end in restricted areas of the superior colliculus. A very few fibers passed into the zona incerta.

1376

Johns Hopkins U. [Dept. of Medicine] Baltimore, Md.

COMMISSURAL CONNECTIONS IN THE NEOCORTEX OF MONKEY (Abstract), by F. F. Ebner and R. E. Myers. [1962] [1]p. (AFOSR-66-1117) (AF AFOSR-61-38) AD 641147 Unclassified

Also published in Proc. Internat'l. Union of Physiological Sciences: Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 2: Abstract no. 1096, 1962.

Patterns of fiber degeneration were studied after transection of corpus callosum, anterior commissure and psalterium in the monkey. Using the Nauta-Gygax technique each lobe of the cerebrum was found to receive commissural fibers. The frontal lobe was distinguished by diffuse, relatively dense degeneration throughout the cortical areas. Small degeneration-free foci were found only on the medial and orbital surfaces, and buried in the central fissure. The parietal lobe exhibited richer contrasts with especially dense degeneration throughout inferior parietal gyrus (area 7) while degeneration-free zones characterized the hand and foot subdivisions of postcentral gyrus and dorsal and medial surfaces of superior parietal gyrus. The temporal lobe was remarkable for the general paucity of degeneration. Only in cortex bordering the depths of superior temporal sulcus and in the cortex of more superior reaches of superior and inferior temporal gyri were more dense foci found. The occipital lobe was largely free of degeneration except for those regions approximately coextensive with cortical area 18. The insular cortex exhibited degenerating fibers in profusion in its posterior superior quadrant, in moderate numbers in its anterior superior quadrant, and in small numbers in its inferior quadrants. The cingulate gyrus received degenerating fibers mainly in its dorsal half. Anterior commissure fibers could be clearly traced into the region of inferior temporal convolution.

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Johns Hopkins U. [Dept. of Medicine, Baltimore, Md.

CONNECTIONS OF OCCIPITAL LOBE IN THE MONKEY (Abstract), by P. Black and R. E. Myers. [1962] [1]p. (AFOSR-66-1118) (AF AFOSR-61-38) AD 639511 Unclassified

Also published in Anat. Rec., v. 142: 216-217, 1962.

The cortical and subcortical patterns of connection were studied after total extirpation of the left occipital lobe in a Macaca mulatta. The removal was limited to areas 17, 18, and 19. In the ipsilateral hemisphere, the Nauta-Gygax technique revealed degeneration in cortex of (a) the inferior temporal gyrus extending into the depths of superior temporal sulcus, (b) the angular gyrus extending into the depths of the posterior portion in the intraparietal sulcus, (c) the arcuate gyrus, (d) lightly over medial surface of superior parietal gyrus bordering the lesion, and (e) in the subculum of temporal lobe. In the contralateral hemisphere, while degeneration was less pronounced, the pattern resembled that described for the ipsilateral hemisphere. A notable exception occurred in the inferior temporal gyrus where only scattered loci of degeneration were noted. The occipital lobe contralateral to the lesion was entirely free of degeneration apart from that zone corresponding to area 18. Study of subcortical structures revealed degeneration in (a) the entire tail and in dorsolateral portions of the body of caudate, (b) the entire claustrum, (c) small posterior superior portions of putamen, (d) posterior portions of reticular nucleus of thalamus and in zona inerta, (e) in the inferior and lateral pulvinar nuclei, lateral geniculate nucleus, lateral posterior nucleus, and dorsomedial nucleus of thalamus, (f) in superior colliculus and pretectal region, and (g) in rostrolateral portions of pontine nucleus.

1378

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

[NEW PARTICLES AND THEIR INTERACTION WITH NUCLEONS] Final rept. July 1, 1956 - Dec. 31, 1962 [13]p. incl. refs. (AFOSR-2661) (AF 18(603)143) AD 277922 Unclassified

This report is a summary of the work accomplished in high energy physics under this contract. The primary purpose of the proposed program was the study of the properties of the new particles that had been discovered in cosmic rays and at high energy accelerators. One by-product of the study was the actual discovery of one of the new particles. The initial technique used was that of photographic nuclear emulsion, but as the nature of the field changed, the newer technique of the bubble chamber was more frequently used.

1379

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

AN ANALYSIS OF THE PRODUCTION OF η AND ω MESONS BY THE INTERACTIONS OF PIONS WITH DEUTERIUM, by T. Toohig, R. Kraemer and others. [1962] [4]p. incl. diagrs. (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 Proc. 1962 Internat'l. Conf. on High-Energy Physics at CERN, Geneva (Switzerland) (July 4-11, 1962), Geneva, CERN, Scientific Information Service, 1962, p. 99-102.

The 72-in. bubble chamber filled with liquid deuterium was used to study multi-pion resonances occurring in π-D interactions at a beam momentum of 1230 mev/c. The effective mass distribution for the 3-pion system from events fitting the reaction $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^- + \pi^0$ is shown. The peak of the η meson is at 546 mev; the peak of the ω meson, 769 mev. The impulse model of nuclear reactions was used to analyze the events as π-N interactions. The number of η's and ω's produced as a function of the total energy in the π-N center of mass and the production angular distribution of η's and ω's are shown. The absolute cross sections for the production of η's and ω's at this beam momentum, that subsequently decay by charged modes were determined to be σ_η = 0.22 ± 0.06 mb and σ_ω = 1.3 ± 0.4 mb.

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Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

THE DECAYS OF THE η AND THE ω MESONS, by M. Meer, R. Strand and others. [1962] [5]p. incl. diagrs. (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 Proc. 1962 Internat'l. Conf. on High-Energy Physics at CERN, Geneva (Switzerland) (July 4-11, 1962), Geneva, CERN, Scientific Information Service, 1962, p. 103-107.

The decays of the η and the ω mesons were studied in the reactions $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^- + \pi^0$ and $\pi^+ + d \rightarrow p + p +$ neutrals. The total cross section for production of η mesons that subsequently decay by a neutral mode was found to be 0.68 ± 0.2 mb. The neutral-to-charged decay ratio for η is 3.1 ± 1.2. The upper limit on the corresponding ratio for ω is 7 ± 6%, and for ω 6 ± 40%. Possible spin and parity assignments for ω and η are suggested.

1381

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

INVESTIGATION OF THE REACTION $K^- + He^4 \rightarrow Y_1^{*-} + He^3$ (Abstract), by M. Meer, A. Pevsner and others. [1962] [1]p. (In cooperation with Northwestern U., Evanston, Ill.). (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)143], National Science Foundation, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 49, Jan. 25, 1962.

The at-rest reaction $K^- + He^4 \rightarrow \Lambda^0 + \pi^- + He^3$(1) is being investigated in a helium bubble chamber exposed to a slow K^- beam at the Bevatron. Strong evidence has already been found in reaction (1) for the production of Y_1^{*-} via $K^- + He^4 \rightarrow Y_1^{*-} + He^3$, $Y_1^{*-} \rightarrow \pi^- + \Lambda^0$, and our new data confirm this effect. If the kaon is pseudoscalar and the absorption occurs in an s state, then the angular distribution of the decay products of the Y^* (in its rest frame) is isotropic for a Y^* of spin 1/2, whereas it is $1 + 3\cos^2\theta$ for spin 3/2. The above argument neglects final state interactions. The original data suggested isotropy. New experimental results of higher statistical confidence will be presented.

1382

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

SYSTEMATICS OF Σ PRODUCTION FROM THE INTERACTIONS OF PIONS WITH DEUTERIUM, by R. Kraemer, M. Nussbaum and others. [1962] [4]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)143] and National Science Foundation) Unclassified

Published in Proc. 1962 Internat'l. Conf. on High-Energy Physics at CERN, Geneva (Switzerland) (July 4-11, 1962), Geneva, CERN, Scientific Information Service, 1962, p. 273-276.

The Berkeley bevatron and the Alvarez 72 in. bubble chamber filled with deuterium were used in investigating charged Σ hyperon production in $\pi^\pm$-deuterium interactions. Invariant mass histograms for the reactions $\pi^+ + d \rightarrow \Sigma^+ + K^+ + n$ and $\pi^- + d \rightarrow \Sigma^- + K^+ + n$ are shown. Comparison of experimental distributions with phase space predictions indicates that strong final state interactions are small if present at all in these processes. Total cross sections were determined as follows: for $\pi^+ + p + (n_s) \rightarrow \Sigma^+ + K^+ + (n_s)$, (0.171 ± 0.031) mb; for $\pi^+ + n + (p_s) \rightarrow \Sigma^+ + K^0 + (p_s)$, (0.177 ± 0.033) mb; for $\pi^- + p + (n_s) \rightarrow \Sigma^- + K^+ (n_s)$, 0.200 ± 0.028 mb; and for $\pi^- + n + (p_s) \Sigma^- + K^0 + (p_s)$, (0.185 ± 0.035) mb, where n_s and p_s represent the non-interacting nucleon.

1383

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

TWO-PION RESONANCES BELOW MASS 900 MEV, by C. Richardson, R. Kraemer and others. [1962] [3]p. incl. diagrs. (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 Proc. 1962 Internat'l. Conf. on High-Energy Physics at CERN, Geneva (Switzerland) (July 4-11, 1962), Geneva, CERN, Scientific Information Service, 1962, p. 96-98.

The reactions $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^-$ (1) and $\pi^- + d \rightarrow p + p + \pi^- + \pi^-$ (2) were observed in the Lawrence Radiation Lab. 72 in. bubble chamber exposed to 1.23 gev/c pions from the bevatron. Histograms of the invariant mass of the $\pi^+ \pi^-$ system in reaction (1) are shown. The ρ meson is seen in the vicinity of 700 mev and higher. There are departures from phase-space in the 620-650 mev and 550-600 mev regions of the order of 2 standard deviations, but the statistics are insufficient to draw firm conclusions. A 3-standard-deviation departure from the smoothed background is seen at about 420 mev. A histogram of the invariant mass of the $\pi^- \pi^-$ system in reaction (2) shows a 3-standard-deviation bump near 600 mev.

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Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE SPECTRA OF RARE EARTH IONS, by G. H. Dieke. Final rept. Jan. 31, 1962 [16]p. incl. diagrs. refs. (AFOSR-2305) (AF 49(638)535) AD 611157 Unclassified

The primary purpose of the work was to obtain the energy levels and other data of the free trivalent rare earth ions in order to have a sound basis for comparison with the levels of the same ions in solid state matter. The procedure of attacking the problem was to establish first the proper experimental conditions for obtaining and separating the various stages of ionization. A new method was developed by studying the time decay of the individual lines in the afterglow of a spark with time resolution of the order of 10^{-7} sec. The third and fourth spectra of the following rare earths were photographed extensively: Pr, Nd, Gd, Ho, Er, Yb. Exploratory results were achieved on the remaining ones (except Pm). Wave length measurements, often 20,000 to 30,000 lines per element, were made on most of the 6 elements. The spectra of divalent ions of Pr and Yb were also analyzed.

1385

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

INTENSITIES OF CRYSTAL SPECTRA OF RARE-EARTH IONS, by G. S. Ofelt. [1962] [10]p. incl. table, refs. (AFOSR-J102) (AF 49(638)535) AD 400174 Unclassified

Also published in Jour. Chem. Phys., v. 37: 511-520, Aug. 1, 1962.

Magnetic and electric dipole transitions between levels of the $4f^x$ configuration perturbed by a static crystalline field are treated. The expression obtained for the pure-electronic electric-dipole transition probability involves matrix elements of an even-order unit tensor between two $4f^x$ states involved in the transition. The contributions to the transition probability from interactions, via the crystalline field, with the $nd^9 4f^{x-1}$, $4f^{x-1}nd$, $4f^{x-1}ng$ configurations are shown to add linearly, in such a way as to multiply each odd k crystal-field parameter A_k^q by a constant. If J mixing in the $4f^x$ configuration is neglected then ΔJ between the upper and lower $4f^x$ levels is restricted to 6 units or less. If L mixing is neglected then ΔL is also restricted to 6 units or less. Application is made to the fluorescence spectra of $PrCl_3$ and $EuCl_3$. Many of the missing and weak transitions are explained. (Contractor's abstract)

1386

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

INTERPRETATION OF RARE-EARTH AND ACTINIDE SPECTRA (Abstract), by B. G. Wybourne. [1962] [1]p. [AF 49(638)535] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 238, Mar. 26, 1962.

Using the complete electrostatic and spin-orbit interaction matrices of the 3 highest multiplicities of the f^n electron configurations, an interpretation of the spectra of several rare-earth and actinide spectra has been made. Several new assignments are reported. The excited states of the rare-earth and actinide ions are shown to exhibit large deviations from Russel-Saunders coupling. The ground states of several actinide ions are shown to contain appreciable admixtures of states of the third highest multiplicity, which have hitherto been overlooked. In view of the large departures from Russell-Saunders coupling, revised parameters are given for the actinide ions. The significance of configuration interaction is considered.

1387

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

NUCLEAR MOMENTS AND INTERMEDIATE COUPLING, by B. G. Wybourne. [1962] [5]p. incl. refs. [AF 49-(638)535] Unclassified

Published in Jour. Chem. Phys., v. 37: 1807-1811, Oct. 15, 1962.

The effect of intermediate coupling on the calculation of the nuclear moments of the rare earths from analyses of hyperfine structure is examined. It is shown that the observed hyperfine splittings may be satisfactorily interpreted as due to the interaction of the spin and orbital moments of 4f electrons with the nuclear magnetic and electric quadrupole moments. The interaction of the electron-spin moments with the nuclear magnetic moment is shown to be very sensitive to the form of the coupling. The consistency of the measurements of nuclear moments by atomic-beam and paramagnetic resonances is discussed. Instead of using the more usual spin-Hamiltonian formalism, the matrix elements of the interactions are calculated explicitly in terms of the actual quantum numbers of the states involved. Calculations are presented for Pr^{141} and Ho^{165}.

1388

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

K° PRODUCTION IN K-p INTERACTIONS AT 2.26 BEV/C, by R. Kraemer, L. Madansky and others. [1962] [11]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-134] and National Science Foundation) Unclassified

The following K^+-p interaction has been studied: $K^+ + p \rightarrow K^+ + \pi^- + p + \pi^+$. Results are presented in graph form.

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Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE SPECTRA OF DOUBLE AND TRIPLY IONIZED RARE EARTHS, by G. H. Dieke. Final rept. Dec. 31, 1962 [2]p. (AFOSR-4820) (AF AFOSR-62-238) AD 412 AD 412671 Unclassified

The object of this research was the production, analysis, and interpretation of the spectra of the doubly and triply ionized rare earths. The main purpose was the establishment of the energy level systems of the $4f^n$ configuration of these ions so that they can be compared with the analogous levels of the ions in crystal lattices.

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Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

SPECTRUM OF DOUBLY IONIZED GADOLINIUM, by W. R. Callahan. [1962] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-J882) (AF AFOSR-62-238) AD 415778 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 695-700, June 1963.

The spectrum of doubly ionized gadolinium was photographed and measured over the region 1900-12,000 A. The following transitions involving 18 levels and 42 lines were classified: $4f^7(^8S_{7/2})6s$-$6p$ and $4f^7(^8S_{7/2})5d$-$6p$. The Coulombic and spin-orbit matrix elements of the $f^7(^8(S_{7/2})l$ states were evaluated and the energy levels calculated. Close agreement was obtained between the calculated and experimental values. These calculations indicate that the $4f^7(^8S_{7/2})6p$ states are close to J_{1j} coupling while those of $4f^7(^8S_{7/2})5d$ are close to LS coupling. (Contractor's abstract)

1391

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

STRUCTURE OF THE f^6 CONFIGURATION WITH APPLICATION TO RARE-EARTH IONS, by G. S. Ofelt. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-J883) (AF AFOSR-62-238) AD 415852 Unclassified

Also published in Jour. Chem. Phys., v. 38: 2171-2180, May 1, 1963.

Free-ion energy-level schemes for the $4f^6$ and $4f^8$ configurations of Eu^{3+}, Sm^{2+}, and Tb^{3+} are given, which have been calculated from energy matrices including interactions among the 3 highest multiplicities. The values obtained for the parameters are $F_2 = 401\ cm^{-1}$, $\zeta = 1320\ cm^{-1}$ for Eu^{3+}; $F_2 = 330\ cm^{-1}$, $\zeta = 1050\ cm^{-1}$ for Sm^{2+}; and $F_2 = 434\ cm^{-1}$, $\zeta = 1705\ cm^{-1}$ for Tb^{3+}. The wavefunctions and g values for levels to 40,000 cm^{-1} are tabulated for Eu^{3+} and Tb^{3+}. Application of the free-ion wavefunctions to the Stark splitting of $EuCl_3$ and $TbCl_3$ is discussed. (Contractor's abstract)

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Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

ANALYSIS OF THE THIRD SPECTRUM OF PRASEODYMIUM, by J. Sugar. [1962] [9]p. incl. illus. diagrs. tables, refs. (AFOSR-J972) [AF AFOSR-62-238] AD 417144 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 831-838, July 1963.

The spectrum of doubly ionized praseodymium was recorded and analyzed, with the result that 118 energy levels of odd parity and 130 levels of even parity were derived. These include nearly all the levels of the $4f^3$, $4f^25d$, $4f^26s$, and $4f^26p$ configurations as well as some low levels of the $4f5d^2$ and $4f^26d$ configurations. Electrostatic and spin-orbit parameters were determined for the $4f^26s$ configuration. From the hfs of the $4f^26s$ levels, a magnetic dipole interaction constant of 0.46 cm^{-1} was obtained. An ionization potential of 23.2 v was calculated from levels of the $4f^25d$ and $4f^26d$ series. (Contractor's abstract)

1393

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

FUNCTIONAL PROPERTIES OF NEURONS OF THE ANTERIOR ECTOSYLVIAN GYRUS OF THE CAT, by M. Carreras and S. A. Anderson. [1963] [27]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1087) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)493, and Public Health Service) AD 441483 Unclassified

Also published in Jour. Neurophysiol., v. 26: 100-126, Jan. 1963.

A single-unit analysis study of the anterior ectosylvian gyrus has been performed on cats lightly anesthetized with barbiturates. The second somatic area contains a large population of cells called modality-place-specific. They are activated in large majority from the skin of the contralateral side of the body, and they subtend small, constant contralateral receptive fields. Taken together

these receptive fields compose a richly detailed representation of the entire body surface. Although a few cells were encountered which were activated from deep tissues only, no single cell was observed which was activated by the gentle rotation of joints, a finding in striking contrast to those previously made in the first somatic area (SI). The second somatic area contains another population of cells which are labeled place-modality-nonspecific. These number about 20% of the total number of cells studied. They are found more commonly as the recording site is translated posteriorly and superiorly along the axis of the anterior ectosylvian gyrus. Their distribution zone overlaps the hind-leg zone of SII and they are found very commonly in that narrow zone of cytoarchitectural transition between SII and AII.

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Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

FAR INFRARED INTERFEROMETRIC SPECTROSCOPY, by J. Strong. Final rept. Feb. 1, 1962 [9]p. incl. refs. (AFOSR-2422) (AF 18(600)1307) AD 278108 Unclassified

Research concerning the first practical application of Fourier transformation used to obtain high resolution spectroscopic information from 2-beam interferometric observations is summarized. This procedure is applied in the far infrared by a lamellar grating interferometer. The procedures have been used to determine the spectra of gases and solids. A quantitative explanation of interference effects that produce the iridescence of crystals of $KClO_3$ was developed. (Contractor's abstract)

1395

Jonker Business Machines, Inc., Gaithersburg, Md.

TOTAL DATA PROCESSING. [1962] [4]p. incl. illus. diagrs. (AFOSR-3276) (AF 49(638)961) AD 432580 Unclassified

Also published in Data Processing Mag., v. 4: 43-46, Apr. 1962.

In total data processing, equipment best suited for conventional data processing is combined with Jonker equipment to take full advantage of the possibilities of inverted data processing. The result is an optimum system which utilizes the best of the 2 basic modes of data processing. This unique total information system comprises a computer (or punched card system) for collecting and organizing the search data. The data is then automatically entered into Minimatrex cards which are disseminated to the various user locations, each of which has a Minimatrex reader. After performing his own search, the user requests the document by serial number. Various ways, all based on microform techniques, are available for providing copies of the requested documents to the users.

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Kansas State U. [Dept. of Chemical Engineering] Manhattan.

A FINITE DIFFERENCE ANALYSIS OF LAMINAR MAGNETOHYDRODYNAMIC FLOW IN THE ENTRANCE REGION OF A FLAT RECTANGULAR DUCT, by C. L. Hwang and L. T. Fan. [1962] [15]p. incl. diagrs. tables, refs. (AFOSR-65-1430) [AF AFOSR-64-463] AD 623061 Unclassified

Also published in Appl. Scient. Research, v. 10B: 329-343, 1962.

The development of the velocity profile, from a uniform one at the entrance, for an electrically conducting fluid entering a semi-infinite flat duct with a transversely applied magnetic field is investigated. It is assumed that the fluid has constant physical properties, the duct walls are electrically non-conducting, a uniform magnetic field is imposed perpendicular to the duct walls, and there can be a net electrical current flow parallel to the walls and perpendicular to the flow direction with a variable external resistance connecting the 2 side plates, which are displaced at infinity. The basic governing continuity and momentum equations are expressed in finite difference form and solved numerically on a high-speed digital computer with a mesh network superimposed on the flow field. A practical mesh size ratio suitable for computation was determined. Results were obtained for the variations of velocity and pressure distribution between the inlet and the region for the fully developed velocity profile for Hartmann numbers of 0, 4 and 10. (Contractor's abstract)

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Kansas U. Dept. of Chemistry, Lawrence

SPECTROPHOTOMETRIC DETERMINATION OF KETONES BY BOROHYDRIDE REDUCTION, by I. Lichtenstein and C. A. Reynolds. [1961] [6]p. incl. table. (AFOSR-64-0129) [AF 49(638)472] AD 430882 Unclassified

Also published in Trans. Kansas Acad. Sci., v. 64: 315-320, 1961.

For abstract see item no. 1263, Vol. V.

1398

Kansas U. [Dept. of Chemistry] Lawrence.

LOW TEMPERATURE VOLTAMMETRY, by R. N. Adams. Final rept. Sept. 19, 1962, 1v. incl. illus. diagrs. tables, refs. (AFOSR-3483) (AF 49(638)822) Unclassified

The research accomplished covers 2 main areas: (1) exploratory studies of fundamental electrochemistry at low temperatures, and (2) investigation of the properties of electroiytically generated free radical ions at room and low temperatures. Activation energies were determined and well defined chronopotentiograms were obtained for the following compounds from room temperature down to approx -75°C: nitroethane, 2-nitropropane, 1-nitropropane, Cd^{++}, nitromethane, nitrobenzene, HCl, $HClO_4$, 2-nitrodiphenylamine, 2-nitrofluorene, 2-nitromesitylene, nitrocyclohexane, and 5-nitronaphthalene. The results are contained in 7 reprints and preprints appended to this report.

1399

Kansas U. Dept. of Chemistry, Lawrence.

ANALYSIS OF THE EPR SPECTRUM OF N,N'-TETRAMETHYLBENZIDINE POSITIVE ION, by Z. Gales and R. N. Adams. [1962] [1]p. (AFOSR-3758) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)822 and Atomic Energy Commission) Unclassified

Also published in Jour. Chem. Phys., v. 36: 2814, May 15, 1962.

The ion was prepared by anodic oxidation of N,N'-tetramethylbenzidine at a Pt electrode in 50% acetone-aqueous buffer at pH 3.8. The spectrum consisted of 11 major groups, each split into 6 lines. Crystal violet was deuterated and the corresponding ring-deuterated N,N'-tetramethylbenzidine was prepared by chemical oxidation. This spectrum confirmed that the major coupling in the ion is due to Me protons.

1400

Kansas U. Dept. of Chemistry, Lawrence.

ELECTRON PARAMAGNETIC RESONANCE AND ELECTROCHEMISTRY. STUDIES OF ELECTROCHEMICALLY GENERATED RADICAL IONS IN AQUEOUS SOLUTION, by L. H. Piette, P. Ludwig, and R. N. Adams. [1962] [6]p. incl. illus. diagrs. refs. (AFOSR-3759) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)822] and Atomic Energy Commission) Unclassified

Also published in Anal. Chem., v. 34: 916-921, July 1962.

The electrochemical generation of radical ions directly in the microwave cavity of an EPR spectrometer has been applied to a variety of processes in aqueous media with considerable success. Cyclic voltammetry coupled with the EPR technique is particularly useful in studying complex organic electrode reactions. Rather unusual stabilities for radical anions of aromatic and aliphatic nitro compounds in aqueous solutions have been found. The utility of EPR in elucidating organic electrode reactions of electroanalytical significance is indicated. (Contractor's abstract)

1401

Kansas U. Dept. of Chemistry, Lawrence.

ELECTRON PARAMAGNETIC RESONANCE OF

AROMATIC AND ALIPHATIC NITRO ANIONS IN AQUEOUS SOLUTION, by L. H. Piette, P. Ludwig, and R. N. Adams. [1962] [4]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)822] and Atomic Energy Commission) Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 4212-4215, Nov. 20, 1962.

A wide variety of aromatic and aliphatic nitro anion radicals can be generated in aqueous media. The lifetimes are reasonably long. The epr spectra can be interpreted with ease in most cases. One of the most significant findings is that a relatively large solvent effect on the N^{14} coupling constant exists for the aromatic compounds, whereas it is absent in the spectra of the aliphatic compounds. (Contractor's abstract)

1402

Kansas U. Dept. of Chemistry, Lawrence.

THE POLAROGRAPHIC DIFFUSION COEFFICIENT, by R. J. Bearman. [1962] [2]p. (AFOSR-J755) [AF AFOSR-61-7] AD 414042 Unclassified

Also published in Jour. Phys. Chem., v. 66: 2072-2073, Oct. 1962.

For the purpose of comparing the polarographic diffusion coefficients with other diffusion coefficients, the derivation of Fick's law as it applies to common polarography experiments is investigated. It is found that the polarographic diffusion coefficient is closely related to the tracer diffusion coefficient of the electroactive ion. Strictly speaking, the 2 coefficients are not equal. Nevertheless, it may be found in practice that they are identical within the limits of validity of the limiting current equations themselves.

1403

Kansas U. Dept. of Chemistry, Lawrence.

THERMOGRAVITATIONAL THERMAL DIFFUSION IN LIQUIDS. I. THE FORMAL THEORY. THERMOGRAVITATIONAL THERMAL DIFFUSION IN LIQUIDS II. EXPERIMENTAL THERMAL DIFFUSION FACTORS FOR CARBON TETRACHLORIDE-CYCLOHEXANE AT 25°C, by F. H. Horne and R. J. Bearman. [1962] [31]p. incl. diagrs. tables, refs. (AFOSR-J756) (AF AFOSR-61-7) AD 414291 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2842-2872, Dec. 15, 1962.

The formal theory of the steady state thermogravitational thermal diffusion in binary liquid mixtures is developed. Although the general approach of Furry, Jones, and Onsager is followed, full use of all hydrodynamic and thermodynamic transport equations permits the explicit statement and the subsequent re-examination of the simplifying approximations. The resulting differential and integral equations are solved subject to boundary conditions imposed by the vanishing of all velocities at the apparatus walls. Inclusion of the temperature and composition dependences of the thermodynamic properties of the fluid leads to the appearance in the final equations of a term which quantitatively takes account of the forgotten effect as well as the ordinarily negligible correction terms. The final working equation is valid for the arithmetic mean experimental temperature and the initial uniform composition of the mixture. It is shown that an easily measured composition difference can be substituted for the steady-state vertical composition gradient. In Section II, an experimental investigation of thermogravitational thermal diffusion in carbon tetrachloride-cyclohexane at 25°C is described and thermal diffusion factors for this system are calculated. The procedure for determining the required compositions involves a special weighing technique and Rayleigh interference refractometry. A new method for using the latter is presented. The design, construction, and use of a cylindrical thermogravitational apparatus are discussed. Small numerical corrections are made for the production and thermal diffusion of impurities. Calculated thermal diffusion factors agree well for most compositions with results of pure thermal diffusion measurements. (Contractor's abstract)

1404

Kansas U. Dept. of Chemistry, Lawrence.

THEORY OF THE SORET EFFECT IN ELECTROLYTIC SOLUTIONS, by E. Helfand, R. J. Bearman, and V. S. Vaidhyanathan. Sept. 1962, 6p. incl. refs. (AFOSR-J830) (In cooperation with Bell Telephone Labs., Inc., Murray Hill, N. J.) (AF AFOSR-61-7) AD 416514 Unclassified

Also published in Jour. Math. Phys., v. 4: 160-165, Feb. 1963.

The limiting law for the square-root concentration dependence of the heat of transport of a simple electrolyte is calculated by considering the Soret effect. The calculation is accomplished by relating the intermolecular forces arising from the temperature gradient in the nonuniform Soret stationary state to the equilibrium gradients of chemical potential required to maintain the same concentration gradients. The contribution arising from ion-ion interactions is identical with that determined by Helfand and Kirkwood from a consideration of heat flow accompanying diffusion. Hence, the present work provides a verification of the heat-matter reciprocal relation without explicitly invoking time-reversal invariance.

1405

Kansas U. Dept. of Chemistry, Lawrence.

EXCHANGE INTERACTION WITH ELECTROLYTICALLY GENERATED BENZONITRILE NEGATIVE ION, by P. Ludwig and R. N. Adams. [1962] [3]p. incl. illus. diagr. refs. (AFOSR-65-0529) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-14 and Atomic Energy Commission) AD 613855 Unclassified

Also published in Jour. Chem. Phys., v. 37: 828-830, Aug. 15, 1962.

Benzonitrile negative ion prepared by the in situ electrolytic generation technique shows strong exchange interaction with the parent benzonitrile. In dimethylformamide as solvent system, the EPR spectrum varies between the expected 54-line pattern and a single narrow line depending on the benzonitrile concentration. A bimolecular rate constant of $\sim 10^8$ liters mol^{-1} sec^{-1} can be estimated. (Contractor's abstract)

1406

Karolinska Inst., Stockholm (Sweden).

SYMPATHETIC VASODILATOR OUTFLOW, by B. Uvnäs. Final technical rept. Aug. 28, 1962 [6]p. incl. illus. (AFOSR-64-0985) (AF EOAR-63-15) AD 600380 Unclassified

Electrodes were implanted into the hypothalamus of dogs. Blood flow was measured in the femoral artery with an electromagnetic flow recorder. The circulation of the paw was cut off with a pneumatic cuff to ensure as pure muscle blood flow as possible. The electrodes were cemented into place when the sympathetic vasodilator area was reached as evident from the stimulatory response. Electrical activation of the sympathetic vasodilator area was repeated on the unanesthetized dogs. The circulatory responses and the behavior reactions were simultaneously recorded. As a final step, the animal was again anesthetized and the sympathetic vasodilator system activated to ensure that the electrodes were still in place. The dogs were then sacrificed and the hypothalamus removed for histological examination. (Contractor's abstract)

1407

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

FURTHER STUDIES ON PIGMENT MIGRATION AND SENSITIVITY CHANGES IN THE COMPOUND EYE OF NOCTURNAL INSECTS, by C. G. Bernhard and D. Ottoson. [1961] [2]p. incl. diagr. (AFOSR-130) (AF 61(052)21) Unclassified

Also published in Acta Physiol. Scand., v. 52: 99-100, 1961.

Studies on the isolated eye of the noctuid moth Cerapteryx graminis were conducted during dark adaptation and during adaptation to light of different intensities after exposure of the eye to bright light. From these studies curves were constructed which show (1) the discontinuous dark adaptation curve; (2) sensitivity changes during the exposure of the eye to an adapting light with a relative brightness of -3.4 (has no second phase); and (3) the results obtained with adapting lights with lower light intensities (shows a second phase most pronounced at the lowest intensity of the adapting light).

1408

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

DETERMINATION OF ^{90}SR AND STABLE STRONTIUM IN BONES FROM SHEEP EWES AND THEIR FETUSES, by S. Häggroth and G. Höglund. [1962] [8]p. incl. diagr. tables, refs. (AFOSR-2131) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)21, and National Institutes of Health) AD 630185 Unclassified

Also published in Exper. Cell Research, v. 24: 80-87, June 1961.

The concentrations of Sr^{90} and stable strontium were measured in the bone ash from pregnant sheep ewes and their fetuses. The fetuses weighed from 125 g (Sr^{90}) and 110 g (stable strontium) to 2650 g. In the ewes the average concentration of Sr^{90} was 40.4 (s.d. 6.4) pc/g calcium in the metatarsal diaphyses and 38.4 (s.d. 3.9) pc/g calcium in the vertebrae. The average concentration of stable strontium was 321 (s.d. 37) ppm in the metatarsal diaphyses and 324 (s.d. 26) ppm in the vertebrae. No significant difference between the 2 bones in the concentrations of either Sr^{90} or stable strontium was found. In the fetuses the average concentrations of Sr^{90} and stable strontium in the ash from the ossified parts of the long bone diaphyses was 16.2 (s.d. 2.5) pc/g calcium and 152 (s.d. 27) ppm respectively. The average ratio between the strontium concentrations in the long bones of each fetus and the metatarsal bones of its mother was 0.41 (s.d. 0.06) for Sr^{90} and 0.48 (s.d. 0.08) for stable strontium. The strontium concentrations in the fetal and maternal bone ash, and the ratio between these concentrations, were essentially independent of fetal weight and sacrifice date. (Contractor's abstract)

1409

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

X-RAY DIFFRACTION STUDIES ON PERIPHERAL NERVE MYELIN, by G. Höglund and H. Ringertz. [1961] [6]p. incl. illus. diagrs. table, refs. (AFOSR-2133) (AF 61(052)21) AD 630187 Unclassified

Also published in Acta Physiol. Scand., v. 51: 290-295, 1961.

The dimension of the radial repeating unit was measured on peripheral nerve from 15 species belonging to 4 vertebrate classes. In the fishes the dimension was 161 ± 3A and in the birds 172 ± 5A. In the mammalian and amphibian species the dimensions were in agreement with earlier work (145 ± 3A, and 171 ± 3A, respectively). Diffraction patterns from brachial plexus nerves of sheep fetuses were obtained from a gestation age of approximately 90 days. Weak lines indicating a lower number of regularly arranged radial repeating units compared to older fetuses were obtained from fetuses

between 90 and 105 days gestation age. The diffraction patterns from fetuses older than approximately 105 days gestation age were similar to those from peripheral nerves of adult sheep. (Contractor's abstract)

1410

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

PIGMENT POSITION AND LIGHT SENSITIVITY IN THE COMPOUND EYE OF NOCTUID MOTHS, by C. G Bernhard and D. Ottoson. [1962] [2½]p. (AFOSR-2851) (AF 61(052)21) Unclassified

Also published in Acta Physiol. Scand., v. 54: 95-96, 1962.

In electrophysiological and histological investigations on the noctuid moth (Cerapteryx graminis) the relation between pigment position and light sensitivity has been studied at varying adapting light intensities covering 7 log units. Electrophysiological studies demonstrated that adaptation to light intensities above -4. 6 is not followed by a second phase in the adaptation curve and there is no pigment migration. The adaptation curves obtained at different light intensities below -4, on the the other hand, are characterized by a second phase and the final threshold value of this phase decreases with decreasing intensity of the adpating light between -4 and -7. At intensities below -7 there is no further decrease of the final threshold value which is equal to that obtained after dark adaptation. A direct relationship was found between the intensity of the adapting light and the maximum sensitivity reached at the end of the second phase of the adaptation curve. Histological studies showed that whereas the pigment in eyes adapted to light above -4 remained in the extreme light-adapted position, the pigment of the eyes adapted to light intensities below -7 showed the extreme dark-adapted position.

1411

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

ANALYSIS OF PRENATAL SPINAL REFLEX ACTIVITY IN SHEEP, by L. Änggard, R. Bergström, and C. G. Bernhard. [1961] [9]p. incl. diagrs. table, refs. (AFOSR-65-1571) (AF 61(052)21) AD 629561 Unclassified

Also published in Acta Physiol. Scand., v. 53: 128-136, 1961.

An electrophysiological analysis was made of the prenatal development of the reflex muscular response to stretch in 17 non-anesthetized sheep fetuses (calculated gestational age 53-132 days) kept in placental contact with the decerebrate ewe. Electrical muscle activity recorded with needle electrodes in the gastrocnemius muscle in response to stretch of the muscle appeared around the 60th day and was shown to be of reflex order. Antagonistic inhibition and inhibition evoked by skin stimulation were not found until later on, there being a short period in which no signs of central inhibition were obtained. Decerebrate rigidity was not obtained until the end of the gestation period, the total length of which is about 150 days in sheep. (Contractor's abstract)

1412

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

OBSERVATIONS ON THE FUNCTIONAL DEVELOPMENT OF THE NEUROMUSCULAR APPARATUS IN FETAL SHEEP, by L. Änggard and D. Ottoson. [1962] [11]p. incl. illus. diagrs. refs. (AF 61(052)21) Unclassified

Published in Exper. Neurol., v. 7: 294-304, Apr. 1963.

The present paper describes the results of a study on the prenatal development of muscle activity in the sheep. Recordings have been made of the mechanical and electrical responses of the gastrocnemius muscle in fetuses (weight 0. 24-1930 gm) in placental contact with the ewe. In the earliest part of the active period of the fetus, the duration of the mechanical response of the gastrocnemius muscle is about 0. 8 to 1 sec and the latency of the response about 6 msec. With increasing gestational age, contraction time and relaxation time become shorter and the latency of the response decreases. About the one-hundredth day of the gestational period, the twitch takes less than 0. 3 sec and the latency of the response has decreased to 1. 5 or 2 msec. Parallel with these changes, there is an increase in frequency of the stimulation required to obtain fusion of contraction. As development proceeds, the conduction velocity of the nerves rises from values less than 1 m/sec during the early stage of the active period to 35 to 75 m/sec after the one-hundredth day. This change coincides with the myelination of the nerve fibers.

1413

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

MICRO X-RAY DIFFRACTION CAMERA FOR STUDIES OF ORIENTATION TEXTURES AND SINGLE MICROCRYSTALS, by J.-E. Glas. [1962] [3]p. incl. illus. diagr. (AFOSR-2388) (AF 61(052)386) AD 400069 Unclassified

Also published in Jour. Scient. Instr., v. 39: 60-62, Feb. 1962.

A description is given of an evacuable micro x-ray diffraction camera provided with 3 different interchangeable specimen holders. This equipment may be used for orientation texture studies, for registration of oscillation and rotation diagrams from single microcrystals, as well as for ordinary micro diffraction work. (Contractor's abstract)

1414

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

STUDIES ON THE ULTRASTRUCTURE OF CALCIFIED TISSUES, by J.-E. Glas. 1962, 24p. incl. refs. (AFOSR-4572) [AF 61(052)386] AD 400846 Unclassified

The mineral phase of bone dentin and enamel has been studied by means of various biophysical methods such as x-ray crystallography, polarized light microscopy and microradiography. Incidentally other methods of investigation have also been applied, i.e., infrared spectroscopy, x-ray fluorescence spectroscopy as well as conventional chemical methods. By means of x-ray crystallography the size and shape of the apatite crystallites in bone and enamel have been determined using the line-broadening technique. The reactivity pattern of the apatite crystallites in hard tissues against foreign ions incorporated in these tissues were studied using most of the methods given in the first paragraph. Studies on crystallite orientation in normal human tooth enamel have been performed by aid of micro x-ray diffraction and polarized light microscopy. In order to get complete information about the 3-dimensional orientation of the apatite crystallites, a new micro x-ray diffraction technique was developed. The degree of mineralization of enamel from normal permanent human teeth was studied on a microscopical level using quantitative microradiography. Polarized light microscopy investigations on corresponding enamel regions were also performed. On the basis of results obtained on the ultrastructure of dental enamel, an extensive discussion was given on the different factors influencing the polarized light microscopy picture of enamel.

1415

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

STUDIES ON THE ULTRASTRUCTURE OF DENTAL ENAMEL. VI CRYSTAL CHEMISTRY OF SHARK'S TEETH, by J.-E. Glas. [1962] [12]p. incl. illus. diagrs. table, refs. (AFOSR-3211) [AF 61(052)386] AD 400171 Unclassified

Also published in Odontol. Revy, v. 13: 315-326, 1962.

Shark's teeth were investigated by means of various biophysical and chemical methods. The size and orientation of the apatite crystallites in the hard layer covering the teeth as well as the degree of mineralization of this layer was found to be very much the same as in true enamel. In contrast to the hydroxyapatite occurring in enamel of higher vertebrates the inorganic phase of shark's "enamel" consists of an almost pure fluorapatite.

1416

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

A CORNEAL NIPPLE PATTERN IN INSECT COMPOUND EYES, by C. G. Bernhard and W. H. Miller. [1962] [2]p. incl. illus. (AFOSR-J607) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-62-13, Public Health Service, and Swedish Medical Research council) AD 414374 Unclassified

Also published in Acta Physiol. Scand., v. 56: 385-386, 1962.

In electron microscope studies, it has been found that the corneal surface of the facets of certain insect compound eyes contain congruent cone-shaped protuberances. These nipples are arranged in a more or less perfect hexagonal array that completely covers the corneal surface. They are absent in extracorneal chitin. Both the altitude of the nipples and their center-to-center distance are approx 200 mu. This nipple pattern has been found on the corneas of compound eyes from insects belonging to Lepidoptera, i.e., butterflies and moths (Prodenia, Cerapteryx, Vanessa); Neuroptera, i.e., net flies (Myrmeleon); and Trichoptera, i.e., caddis flies (Phryganea). The pattern is absent in corneas of compound eyes of specimens belonging to Hymenoptera, i.e., bees, etc. (Apis, Bombus); Coleoptera, i.e., beetles (Coccinella); and Odonata, i.e., dragon flies (Sympetron). Furthermore, where the pattern is absent the front surfaces of these corneas appear smooth under the electron microscope. Further investigations of the distribution and functional significance of the nipple pattern are in progress.

1417

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

PROTECTIVE EFFECT OF BRETYLIUM ON NORADRENALINE STORES IN ORGANS, by G. Ryd. [1962] [4]p. incl. tables. (AFOSR-4344) (AF 61(052)309) Unclassified

Also published in Acta Physiol. Scand., v. 56: 90-93, 1962.

The noradrenaline content of the liver, heart and kidney of the guinea-pig was increased after an intraperitoneal dose of 50 mg bretylium, given 1/2 to 4 hr previously. No increase was found in the brain. In liver, spleen and heart the depleting action of reserpine on noradrenaline was partially prevented by bretylium, but no effect was noted in the kidney and brain. In organs analyzed 24 hr after injection of bretylium the amounts of catecholamines did not differ from the controls.

1418

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

SOME ASPECTS OF THE ACTIONS OF NATURALLY OCCURRING PRESSOR AMINES, by U. S. von Euler. [1962] [4]p. incl. refs. (AFOSR-4345) (AF 61(052)309) Unclassified

Also published in Canad. Med. Assoc. Jour., v. 86: 981-984, May 26, 1962.

A review is given of some properties of the naturally occurring pressor amines, adrenaline and noradrenaline. Similarities and differences between the 2 amines are pointed out, particularly as regards the actions on the cardiovascular system. The effect of pressor amines on the blood flow in different vascular areas at different initial pressure levels is discussed. It is emphasized that the effects of generalized vasomotor activity and those of circulating noradrenaline may differ in different vascular areas. Indications for the therapeutic use of pressor amines are briefly considered, particularly with respect to conditions of hypotension and shock. It is pointed out that pressor amines may exert a variety of actions in addition to those on the cardiovascular system. Special mention is made of the inhibitory action on ganglionic transmission. Finally some recent results concerning the storage and uptake of catecholamines in nerves and organs are briefly discussed.

1419

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

INFLUENCE OF pH ON UPTAKE AND RELEASE OF NORADRENALINE IN ADRENERGIC NERVE GRANULES, by U. S. von Euler and F. Lishajko. [1962] [5]p. incl. diagrs. refs. (AFOSR-J1420) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)309, Swedish Medical Research Council, and Wallenberg Foundation) AD 427580
Unclassified

Also published in Jour. Neurochem., v. 10: 145-149, Mar. 1963.

The depletion rate of noradrenaline from bovine splenic storage granules in isotonic potassium phosphate decreases as the pH is increased from 7.0 to 8.5. Conversely, the uptake of noradrenaline in partially depleted granules increases as the pH is increased over the range 6.5-8.5, but is relatively independent of temperature between 20° and 37°. The release rate of exogenous noradrenaline, taken up during incubation with the amine in a concentration of 20 µg/ml, follows the course characteristic of the release of the endogenous amine.

1420

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

RESEARCH ON BRAIN STEM MECHANISMS REGULATING AUTOMATIC ACTIVITIES, by U. Söderberg. Technical summary rept. Feb. 6, 1961, 10p. (AFOSR-507) (AF 61(052)119) AD 257512 Unclassified

Summaries of the research conducted under this contract and the subsequent publications are presented. The results are partly reviewed in item nos. 834 and 839, Vol. III and item nos. 1078-1080, Vol. IV. The areas of research include cardiovascular studies, measurement and regulation of cerebral blood flow, brain stem reflexes, and brain stem influence on the lateral geniculate body.

1421

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

QUANTITATIVE MEASUREMENTS OF GLUCOSE UPTAKE AND BLOOD FLOW IN NEURONALLY ISOLATED CAT CORTEX (Abstract), by U. Söderberg. [1962] [1]p. (AFOSR-2903) (AF 61(052)119) Unclassified

Also published in Proc. Internat'l. Union of Physiological Sciences; Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 2: 1118. 1962.

Blood flow and arterial-venus diffusion for glucose were measured in neuronally isolated cortical slabs. An operative procedure by Jöbsis and Söderberg was used and performed in 2 stages. First, the slab is isolated neuronally, all draining veins except the superior sagittal sinus are interrupted and EEG electrodes are mounted with acrylate. In the 2nd stage, after recovery, the sinus is cannulated and the rate of venous outflow measured. Arterial and sigittal sinus blood is repeatedly analyzed for glucose. The glucose uptake was not closely related to the electrical activity in these short-term experiments. A sudden rise in arterial glucose concentration increased the uptake temporarily, probably until the equilibrium between blood and brain was re-established. Insulin increased the cortical glucose clearance. Hypoventilation and low blood pressure reduced or even reversed the uptake. It seems as if the exchange of glucose between blood and brain in the present experiments closely resembles a diffusion process. Changes in size of the cerebral glucose space probably occur in response to various stimuli. Simple uptake measurements do not tell whether glucose that enters the brain will be metabolized immediately or converted to glycogen or to other substances.

1422

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

THE EFFECT OF BLOOD-BORNE INFLUENCES OF THE CEREBRAL CORTEX IN WAKEFULNESS AND SLEEP, by U. Söderberg. [1962] [7]p. incl. refs. (AFOSR-2904) (AF 61(052)119) AD 405415
Unclassified

Also published in Proc. Internat'l. Union of Physiological Sciences; Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 1 (Pt. 1): 457-463, 1962.

As part of the difficult problem to find the differences between wakefulness and sleep; this investigation into the basic problem to determine whether changes in body fluids can be transfered to the central nervous system and their effect, uses the neuronally isolated cortex

slab to measure electrical activity in relation to raised CO_2, and changes in body temperature. The former was not as clear cut as had been expected. Only significant vasodilatation could be obtained in marked contrast to the findings in the intact brain. Changes in the body temperature within physiological limits sometimes altered the electrical activity of the slab, but not as regularly as has been reported to be the case in the cortex of an intact brain. Hypoglycemia has only been studied in a few experiments. The isolated and the intact cortex seem to have essentially the same tolerance, the depression and convulsive activity appeared nearly simultaneously in both. The work of various other experimentors in related areas is reviewed.

1423

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

BLOOD PRESSURE AND PULSE-WAVES IN SMALL CEREBRAL ARTERIES DETERMINED WITH MANOMETERS WITH STIFF MEMBRANES (Abstract), by U. Söderberg. [1961] [2]p. (AFOSR-2906) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)119 and Therese och Johan Anderssons Minne) Unclassified

Also published in Internat'l. Biophys. Cong., Stockholm (Sweden) (July 31-Aug. 4, 1961), Abstracts of Contributed Papers, 1961, p. 129-130.

Earlier attempts to measure the blood pressure in cerebral arteries of cats with strain-gauge manometers have shown that there is a pressure drop from the common carotid artery to the circle of Willis that significantly influences the cerebral blood flow (Söderberg and Weckman: Experientia, v. 15: 346, 1959). However, in the previous experiments, even with the best available manometers, only the mean pressure could be recorded from the narrow brain arteries which demand such narrow catheters that the natural frequency of these previous manometer systems was lowered too much. In order to obtain better temporal resolution a quartz crystal pressure transducer (Kistler/Vibrometer) has, therefore, been used in the present work. This manometer, which never seems to have been utilized for biological measurements before, has a natural frequency of 80,000 cps. This property rules out some of the difficulties encountered in having to use narrow bore catheters. Thus, good pulsations were recorded even from branches of the Arteria cerebri media on the surface of the parietal and temporal lobes. The results of testing the manometer system and of using it for the recording of pulse-waves in small brain arteries as an index of cerebral vasomotor activities are briefly summarized.

1424

Karolinska Inst. Nobel Inst. for Neurophysiology Stockholm (Sweden).

[QUANTITATIVE MEASUREMENT OF BLOODFLOW IN THE ISOLATED CORTICAL LOBE OF THE CAT] Quantitative Bestimmung des Blutstromes in einem nervös isolierten Rindenlappen der Katze, by E. F. Jöbsis and U. Söderberg. [1961] [6]p. incl. illus. diagrs. refs. (AFOSR-2907) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)-119 and Public Health Service) AD 632135 Unclassified

Also published in Verhandl. Deutsch. Gesellsch. Kreislaufforsch., No. 27: 301-308, 1961.

It was possible to record the blood flow from the isolated cortical lobe in a quantitative manner. The current rate matches quickly and delicately the measurement of neuroactivity in these lobes. Wider tests were conducted on the control mechanism of the blood flow and on the speed of oxygen consumption at rest and during activity.

1425

Keele U., Staffordshire (Gt. Brit.).

HEATS OF FORMATION AND BOND ENERGIES OF ORGANOMETALLIC COMPOUNDS, N-BUTYL-LITHIUM, TRIMETHYLALUMINIUM AND TRIETHYLALUMINIUM, by C. T. Mortimer. Final rept. Dec. 31, 1962, 30p. incl. illus. diagr. tables, refs. (AFOSR-4583) (AF 61(052)307) AD 299990 Unclassified

The heats of hydrolysis of n-butyl-lithium and triethylaluminium have been measured, using a Dewar-vessel calorimeter, and the data used to calculate the values ΔHf° (n-BuLi, liq) = 31.4 ± 0.7 kcal/mol, and $\Delta Hf^\circ(Et_3Al, liq)$ = 36.5 ± 5.5 kcal/mol. Using a rotating-bomb calorimeter, the heat of reaction of trimethylaluminium and acetic acid has been determined. The heat of solution of aluminium triacetate in hydrochloric acid has also been obtained. These measurements are used to calculate the values $\Delta Hf^\circ(Me_3Al, liq)$ = 36.1 ± 1.6 kcal/mol and $\Delta Hf^\circ[(CH_3COO)_3Al, cryst]$ = -451.8 ± 0.8 kcal/mol. The mean bond dissociation energies $\bar{D}$(Li-Bu) = 54 ± 9, $\bar{D}$(Al-Et) = 56.8 ± 4.0, and $\bar{D}$(Al-Me) = 64.5 ± 2.0 kcal/mol are derived.

1426

[Keele U.] Staffordshire (Gt. Brit.).

HEATS OF FORMATION AND BOND ENERGIES. PART V. N-BUTYL-LITHIUM, by P. A. Fowell and C. T. Mortimer. [1961] [4]p. incl. table, refs. [AF 61(052)307] Unclassified

Published in Jour. Chem. Soc. (London), No. 735: 3793-3796, Sept. 1961.

The heats of the following reactions of n-butyl-lithium have been measured calorimetrically: $LiC_4H_9(liq) + H_2O(g) - LiOH(cryst) + C_4H_{10}(g)$, ΔH = 57.4 ± 0.7 kcal/mol and $LiC_4H_9(liq) + C_6H_5 \cdot CH_2Br(liq) - LiBr(cryst) + C_6H_5 \cdot C_5H_{11}(liq)$, ΔH = 80.8 ± 2.6

kcal/mol. From these, the heats of formation are calculated: $\Delta H_f^\circ(LiC_4H_9, liq) = 21 \cdot 4 \pm 0 \cdot 7$ kcal/mol, and $\Delta H_f^\circ(C_6H_5 \cdot CH_2Br, liq) = +7 \cdot 1 \pm 3 \cdot 3$ kcal/mol. The value $D(li\text{-}C_4H_9) = 54 \pm 9$ kcal/mol is derived. (Contractor's abstract)

1427

Keele U., Staffordshire (Gt. Brit.).

NEW METHODS OF ANALYSIS OF ELECTROPHYSIOLOGICAL RESPONSES, by D. M. MacKay, D. A. Jeffreys, and R. R. Glover. Final technical rept. June 21, 1962 [40]p. incl. illus. diagrs. (AFOSR-3034) (AF 61(052)364) AD 278590 Unclassified

The development of a simple system for the averaging and analysis of repeated electrical signals is described. Samples are accumulated on a closed loop of magnetic tape, using a special form of pulse-interval modulation, designed also to enable simple circuitry to compute correlations. A low-speed and a high-speed multi-channel model have been developed, with capacities of up to 900 samples per channel. First results with the EEG of human subjects exposed to patterned visual stimuli are described. (Contractor's abstract)

1428

Kentucky U. [Dept. of Chemistry] Lexington.

CHEMISTRY OF N-SULFINYLAMINES, by W. T. Smith, Jr. Final rept. Aug. 31, 1952, 13p. (AFOSR-3469) (AF 49(638)49) AD 284908 Unclassified

Three general methods of preparation of N-sulfinylamines were studied. The first involved the direct reaction of the amine with thionyl chloride in an inert solvent. The second method involved the use of a tertiary base such as pyridine in the reaction mixture to take up the HCl and drive the reaction towards completion. The third method makes use of the trans-sulfinylation reaction. This reaction usually involves the reaction of an aromatic N-sulfinylamine with an aliphatic amine to give the aliphatic N-sulfinylamine and aromatic amine. The second method (use of pyridine) is usually the best method and gives good yields from aliphatic and aromatic amines at room temperature. The kinetics of the trans-sulfinylation reaction has been studied extensively. A number of substituted N-sulfinylanilines were prepared by a direct method in yields over 90%. The pyridine method gave a 60% yield in N-sulfinyl-1-heptylamine. The trans-sulfinylation reaction with N-sulfinylaniline and 1 butylamine gave only an 18% yield of N-sulfinyl-1-butylamine.

1429

Kentucky U. Dept. of Chemistry, Lexington.

ADDITION OF GRIGNARD REAGENTS TO HINDERED N-SULFINYLAMINES, by W. T. Smith, Jr., P. A. Thio, and M. Grasley. [1961] [1]p. (AFOSR-3470) (AF 49(638)49) Unclassified

Also published in Jour. Org. Chem., v. 27: 692, 1962.

For abstract see item no. 1294, Vol V.

1430

Kentucky U. Dept. of Chemistry, Lexington.

PREPARATION OF 2.1,3-BENZOTHIADIAZOLES USING DIMETHYLFORMAMIDE-SULFUR DIOXIDE REAGENT, by W. T. Smith, Jr., and W.-Y. Chen. [1961] [2]p. (AFOSR-3471) (AF 49(638)49) Unclassified

Also published in Jour. Org. Chem., v. 27: 676-677, 1962.

For abstract see item no. 1293, Vol. V.

1431

Laval U. Dept. of Physiology, Quebec (Canada).

NON-SPECIFICITY OF THE IN VITRO I^{131} RELEASE METHOD FOR PLASMA THYROTROPIN (TSH) DETERMINATIONS IN THE RAT (Abstract), by C. Rerup, G. P. Van Rees and others. [1962] [1]p. (AFOSR-2628) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-15 and National Institutes of Health) Unclassified

Presented at Fifth annual meeting of the Canad. Fed. Biol. Soc., Laval U., Quebec (Canada), June 6-8, 1962.

Also published in Proc. Canad. Fed. Biol. Soc., v. 5: 66, 1962.

Bottari and Donovan's in vitro TSH assay based on I^{131}-release by incubated guinea pig thyroid slices, is the most sensitive method hitherto recorded, and has been used for the measurement of plasma TSH in man. Lack of information pertaining to the specificity of the method for TSH prompted a comparative study of the effects of plasma from rats hypophysectomized 6-10 days earlier (hypox plasma), of normal rat plasma and of the incubation medium on the in-vitro response parameter. Pooled hypox plasma evidenced a clear, and concentration-dependent, I^{131}-releasing activity. On the basis of 4-point-2 dose assays against U.S.P. Reference Standard Thyrotropin, this activity was assessed at 86 mU/100 ml, as compared to 170 mU/100 ml for a pool of normal rat plasma. Heparin was inactive, and the activity of hypox rat serum was comparable to that of hypox plasma. This TSH-like activity of extra-pituitary origin raises a question as to the applicability of the in-vitro method for TSH measurements in rat plasma or serum.

1432

Laval U. Dept. of Physiology, Quebec (Canada).

EFFECT OF AGE ON THE CONCENTRATION OF NUCLEIC ACIDS AND THE INCORPORATION OF C^{14} LEUCINE INTO THE RNA-PROTEIN COMPLEX OF THE RAT ADENOHYPOPHYSIS (Abstract), by A. Devi and G. Saucier. [1962] [1]p. (AFOSR-2629) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-15 and National Institutes of Health) Unclassified

Presented at Fifth annual meeting of the Canad. Fed. Biol. Soc., Laval U., Quebec (Canada), June 6-8, 1962.

Also published in Proc. Canad. Fed. Biol. Soc., v. 5: 24, 1962.

The concentration of nucleic acids in the rat adenohypophysis was found to be remarkably high, as compared to other tissues, and to vary with age. A progressive rise of the RNA concentration from 0.910 to 1.205 gm/100 gm of tissue, and of the RNA/DNA ration from 2.22 to 3.0, observed over a weight span of 45 to 300 gm, approximately corresponding to an age span of 8-10 days to 8 weeks, was followed by a slow and gradual decline to 0.88 gm of RNA, and a RNA/DNA ratio of 2.41, for rats of 500-550 gm or 27-30 weeks of age. The in-vitro incorporation of C^{14}-leucine into the RNA-protein complex was likewise related to age and showed a parallel pattern. These age-related changes, however, did not characterize the adenohypophysis, since they were concurrently evidenced, with minor differences in pattern, by other tissues (neurophypophysis, hypothalamus and midbrain). They would thus appear to reflect growth and senescence rather than specific alterations of hormonal synthesis.

1433

Lees Instrument Research, Inc., Cambridge, Mass.

UNCERTAINTY CONCEPTS FOR APPLICATION IN SYSTEMS ANALYSIS, by S. Lees. May 1962 [40]p. incl. diagrs. tables, refs. (AFOSR-2856) (AF 49(638)-1111) AD 284664 Unclassified

Uncertainty of measurements examined by Shannon's theorem and Jayne's formalism leads to a definition of imprecision as bounds enclosing the measured value. Width of bounds is related to system performance and possible malfunction.

1434

Lehigh U. [Dept. of Mathematics] Bethlehem, Pa.

PARALLEL AND CENTRAL TRANSFORMATIONS OF RIEMANNIAN MANIFOLDS, by C. C. Hsiung and H. I. Nassar. Aug. 1961, 51p. incl. refs. (Technical rept. no. 1) (AFOSR-2816) (AF 49(638)1009) Unclassified

Let M^n, M^{*n} be 2 Riemannian manifolds of dimension n (≥ 2) immersed in a Euclidean space E^{n+m} of dimension $n+m$ ($m > 0$). By a parallel transformation f between the manifolds M^n, M^{*n} in the direction of a fixed unit vector E in the space E^{n+m} is meant a diffeomorphism $f: M^n \to M^{*n}$ such that the line joining every pair of corresponding points P, P^* of the manifolds M^n, M^{*n} under f is parallel to the vector E. By a central transformation f between the manifolds M^n, M^{*n} is meant a diffeomorphism $f: M^n \to M^{*n}$ such that the line joining every pair of corresponding points P, P^* of the manifolds M^n, M^{*n} under f passes through a fixed point in the space E^{n+m}. Let Y, Y^* be the position vectors of the points P, P^* in the space E^{n+m}. Then a central transformation of the manifolds M^n, M^{*n} can be given by $Y^* = kY$, and is called a homotheticity if k is constant. Let H_{rp} (respectively H^*_{rp}) be the p-th ($1 \leq p \leq n$) mean curvature of the manifolds M^n (respectively M^{*n}) relative to a unit normal vector e_r (respectively e^*_r) at the point P (respectively P^*).

Various authors have been able to find conditions on the mean curvatures H_{rp} and H^*_{rp} of 2 compact oriented manifolds M^n and M^{*n} immersed in the space E^{n+m} under a parallel (respectively central) transformation f of class C^3 such that f be a translation (respectively homotheticity). The present work discusses parallel transformations for the most general case where n, m, p all can be arbitrary. (Contractor's abstract, modified)

1435

Lehigh U. [Dept. of Mathematics] Bethlehem, Pa.

VECTOR FIELDS AND INFINITESIMAL TRANSFORMATIONS ON ALMOST-HERMITIAN MANIFOLDS WITH BOUNDARY, by A. L. Hilt and C. C. Hsiung. Sept. 1961, 55p. incl. refs. (Technical rept. no. 2) (AFOSR-3419) (AF 49(638)1009) Unclassified

An investigation is made of vector fields and infinitesimal transformations on almost-Hermitian manifolds with boundary. Riemannian manifolds are considered, as well as Lie derivatives over the manifolds, local boundary geodesic co-ordinates, and integral formulas. A Killing vector field on a compact orientable Riemannian manifold is discussed, and almost-Hermitian, almost-semi Kahlerian, and almost-Kahlerian structures are defined. Contravariant analytic vector fields are given consideration on an almost-Hermitian manifold M(n) with boundary B(n-1), together with their relations to Killing, projective Killing, and conformal Killing vector fields. Covariant analytic vector fields on an almost-Hermitian manifold with boundary are studied as well as vector fields on an almost-Kahlerian manifold with boundary.

1436

Leicester U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF SIMPLE COMPOUNDS IN MICROORGANISMS, by H. L. Kornberg. Final technical rept. Sept. 20, 1962 [8]p. incl. illus. refs. (AFOSR-4190) (AF EOAR-61-12) AD 292926 Unclassified

Results obtained indicate that: (1) the formation of isocitrate lyase when E. coli grows on acetate is a consequence of de novo protein synthesis; (2) acetate per se is not an inducer of isocitrate lyase formation but acts in an indirect manner, probably by relieving enzyme repression; (3) growth of Rps. spheroides on acetate, aerobically in the dark or anaerobically in the light, does not involve the glyoxylate cycle; (4) anaerobic growth of an organism, tentatively identified as Cl. kluyveri, on ethanol plus acetate also does not involve the glyoxylate cycle; (5) inducible amidase formation by Ps. aeruginosa growing on acetamide is discontinuous and either the nature of the enzyme formed or its mode of formation is influenced by the nature of the inducing agent; (6) growth of M. denitrificans on glycollate involves a new route in which 3-hydroxyaspartate may be an intermediate; and (7) growth of Pseudomonas sp. on itaconate necessitates its prior activation to itaconyl coenzyme A, which is transformed to pyruvate and acetyl coenzyme A, probably via citramalyl coenzyme A. (Contractor's abstract)

1437

Leicester U. Dept. of Biochemistry (Gt. Brit.).

DISCONTINUITY OF AMIDASE FORMATION BY PSEUDOMONAS AERUGINOSA, by M. Kelly and H. L. Kornberg. [1962] [3]p. incl. diagrs. (AFOSR-4346) (AF EOAR-61-12) Unclassified

Also published in Biochim. et Biophys. Acta, v. 59: 517-510, 1962.

It is shown that the formation of amidase by Pseudomonas aeruginosa 8602/A during growth on acetamide proceeds in 2 distinct phases, and it is suggested that either the nature of the amidase formed, or the mode of its formation, is different when elicited by non-substrate inducers than when elicited by acetamide. When the succinate-grown P. aeruginosa were placed in fresh medium containing 50 mM acetamide as sole source of C and N, the onset of growth was preceded by the formation of amidase, which thereafter continued over 2 generations, at a rate proportional to the increase in cell density. When the concentration of acetamide in the medium, which fell rapidly as a consequence of amidase action, had decreased to less than 1/2 of that initially present, amidase formation ceased. However, a second phase of rapid amidase formation began when acetamide could no longer be detected in the medium and continued throughout the subsequent growth of the cells. The 2 phases of amidase formation could be observed independently of one another.

1438

Leicester U. Dept. of Biochemistry (Gt. Brit.).

IDENTIFICATION OF ENZYMES INVOLVED IN THE FORMATION OF PYRUVATE FROM ITACONYL-COENZYME A, by R. A. Cooper and H. L. Kornberg. [1962] [3]p. incl. table. (AFOSR-4347) (AF EOAR-61-12) Unclassified

Also published in Biochim. et Biophys. Acta, v. 62: 438-440, 1962.

It is reported (see item no. 1439, Vol. VI) that sonic extracts of itaconate-grown Pseudomonas B_2 aba catalyzed the formation of equimolar quantities of acetyl-CoA and pyruvate either from itaconate, ATP and CoA or from itaconyl-CoA, but that similar formation of acetyl-CoA and pyruvate from citramalate, ATP and CoA necessitated the further addition of succinate. It is the aim of this communication to confirm and extend these findings and to report the separation and identification of the enzymes involved in these reactions.

1439

Leicester U. Dept. of Biochemistry (Gt. Brit.).

FORMATION OF PYRUVATE AND ACETYL-COENZYME A FROM ITACONYL-COENZYME A BY PSEUDOMONAS SP., by R. A. Cooper and H. L. Kornberg. [1962] [2]p. incl. refs. (AFOSR-4348) (AF EOAR-61-12) Unclassified

Also published in Biochim. et Biophys. Acta, v. 59: 480-481, 1962.

Pseudomonas B_2aba grew readily on a medium containing 25 mM itaconate as sole C source, and washed suspensions of cells, thus grown, readily oxidized itaconate. However, sonic extracts of such cells failed to oxidize or utilize itaconate unless they were supplemented with $MgCl_2$, ATP and CoA. Under these conditions, 1.8 µmol of pyruvate were formed/h/mg of protein from itaconate. The formation of pyruvate was measured spectrophotometrically. The results indicate that a major pathway for the utilization of itaconate by Pseudomonas B_2aba involves a prior activation of itaconate to itaconyl-CoA and the subsequent transformation of this compound to equimolar amounts of acetyl-CoA and pyruvate. This pathway is therefore different from that postulated by Brightman and Martin (Jour. Bacteriol., v. 82: 376, 1961) and appears to be similar to the mode of itaconate utilization demonstrated to occur in liver mitochondria. Since the extracts of the itaconate-grown organism also catalyzed the formation of pyruvate from citramalate plus cofactors and were rich in pyruvate transacetase, it is likely that the transformation of itaconyl-CoA to pyruvate and acetyl-CoA involves its hydration to citramalyl-CoA.

1440

Leicester U. Dept. of Biochemistry (Gt. Brit.).

AMIDASE FROM PSEUDOMONAS AERUGINOSA: A MULTI-HEADED ENZYME, by M. Kelly and H. L. Kornberg. [1962] [2]p. incl. diagr. table. (AFOSR-4349) (AF EOAR-61-12) Unclassified

Also published in Biochim. et Biophys. Acta, v. 64: 190-191, 1962.

It has been reported that Pseudomonas aeruginosa, during later stages of growth on acetate as sole C source, forms large quantities of an enzyme which is specific for the hydrolysis of several aliphatic amides: $R \cdot CONH_2 + HOH \rightarrow R \cdot COOH + NH_3$ (Reaction 1). Sonic extracts of the organism rich in this enzyme have been found to be capable also of effecting the transfer of the acyl moiety of such amides to hydroxylamine: $R \cdot CONH_2 + NH_2OH \rightarrow R \cdot CONHOH + NH_3$ (Reaction 2). It was found that urea at low concentrations was a powerful inhibitor of amidase activity (Reaction 1) but exerted a negligible effect on transferase activity (Reaction 2). At a concentration of 2.10^{-3} M urea and using propionamide as substrate, the transferase activity of the purified enzyme was identical with that observed in the absence of urea, though no amidase activity was detected. Conversely, the addition of KF affected transferase activity more powerfully than amidase activity. In the presence of 0.1 M KF, the amidase activity was 96% of that in the absence of fluoride where as the transferase activity had been reduced to 18%. The results indicate that 2 enzymic reactions are catalyzed at different rates. If, as seems likely, they are indeed brought about by one enzyme, this enzyme must be regarded as a "multi-headed" enzyme.

1441

Leicester U. Dept. of Biochemistry (Gt. Brit.).

THE INFLUENCE OF GROWTH SUBSTRATES ON OXALOACETATE FORMATION FROM β-HYDROXYASPAR[T]ATE BY MICROCOCCUS DENITRIFICANS, by H. L. Kornberg and J. G. Morris. [1962] [3]p. incl. diagrs. (AFOSR-J200) (AF EOAR-62-77) AD 400057 Unclassified

Also published in Biochim. et Biophys. Acta, v. 65: 378-380, 1962.

Micrococcus denitrificans were grown aerobically in a medium containing sodium glycollate as sole C source. After harvesting, the cells were resuspended in fresh growth media, containing either 25 mM sodium glycollate or 25 mM sodium succinate as sole C source. It was found that when glycollate-grown M. denitrificans continued to grow on glycollate as C source, the rate of hydroxyaspartate dehydratase formation was linearly related to the increase in cell mass. However, when the glycollate-grown cells grew further on succinate as sole C source, the initial hydroxyaspartate dehydratase content of the culture increased only slightly during 3 generations of growth. When succinate-grown M. denitrificans were placed in fresh growth medium containing 25 mM glycollate as sole C source, no growth was detected for the first 2.5 h. However, the initial low hydroxyaspartate dehydratase level rose rapidly. When succinate-grown M. denitrificans were placed in fresh growth medium containing both succinate and glycollate there was only slight hydroxyaspartate dehydratase formation. The results indicate that the enzymic formation of oxaloacetate from erythro β-hydroxyaspartate occurs to a quantitatively negligible extent during the growth of M. denitrificans on succinate but is of importance in this organism's growth on glycollate as sole C source.

1442

Leicester U. Dept. of Biochemistry (Gt. Brit.).

ENZYMIC FORMATION OF OXALOACETATE FROM ERYTHRO β-HYDROXYASPARTATE, by H. L. Kornberg and J. G. Morris. [1962] [4]p. incl. diagrs. (AFOSR-J201) (AF EOAR-62-77) AD 400058 Unclassified

Also published in Biochim. et Biophys. Acta, v. 65: 537-540, 1962.

This communication reports the presence, in extracts of glycollate-grown Micrococcus denitrificans, of an

enzyme catalyzing the formation of oxaloacetic acid from erythro β-hydroxyaspartic acid. It is suggested that this new enzyme, by analogy with other known enzymes catalyzing the formation of α-oxo acids from α-amino β-hydroxyacids, be named "erythro β-hydroxyaspartate hydro-lyase (deaminating)" and carry the name "hydroxyaspartate dehydratase".

1443

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

EFFECT OF ADDED METHANOL ON CONTACT ION PAIRS IN CARBON TETRACHLORIDE, by M. J. Blandamer, T. E. Gough and others. [1962] [2]p. incl. diagrs. [AF EOAR-62-64] Unclassified

Published in Jour. Chem. Phys., v. 38: 1034-1035, Feb. 15, 1963.

It is found that if the band at 34480 cm^{-1}, which appears in the spectrum of solutions of tetra-n-butylammonium iodide in CCl_4, is a property of contact ion pairs, then their concentration is unaffected by methanol up to a concentration of 1.6×10^{-3}m; above this the contact ion pairs are progressively destroyed.

1444

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

EFFECT OF ADDED ELECTROLYTE ON THE ELECTRON SPIN RESONANCE SPECTRA OF SOLUTIONS OF METALS IN AMMONIA, by R. Catterall, J. Corset, and M. C. R. Symons. [1962] [2]p. incl. tables. (AFOSR-68-0303) (AF EOAR-64-80) AD 629208 Unclassified

Also published in Jour. Chem. Phys., v. 38: 272-273, Jan. 1, 1963.

Infrared and electron spin resonance studies have been made of the effect of added electrolytes (Na, K, Cs iodides) on ammonia solutions of alkali metals. The equilibria between the solvated electron and the expanded metal ion is discussed. There was shown to be a definite interaction between the unpaired electrons and the added cations.

1445

Library of Congress. Science and Technology Div., Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY; AN ANNOTATED BIBLIOGRAPHY, VOLUME III, 1954 LITERATURE, by A. J. Jacobius, R. Kenk and others. 1960, 542p. incl. refs. (Sponsored jointly by Advanced Research Projects Agency, [Air Force Office of Scientific Research under ISSA 61-3], Defence Research Board of Canada, and National Aeronautics and Space Administration) Unclassified

With the third volume of this series, the title was changed from Aviation Medicine to Aerospace Medicine and Biology. The bulk of the publication is devoted to material published during the year 1954; however, items published in 1952 or 1953, which were not included in preceding volumes have been incorporated in this volume. The compilation consists of approximately 1300 references, arranged alphabetically by author.

1446

Library of Congress. Science and Technology Div., Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY; AN ANNOTATED BIBLIOGRAPHY, VOLUME IV, 1955 LITERATURE, by A. J. Jacobius, R. Kenk and others. 1961, 330p. incl. refs. (AFOSR-80) (Sponsored jointly by Advanced Research Projects Agency, [Air Force Office of Scientific Research under ISSA 61-3], Defence Research Board of Canada, and National Aeronautics and Space Administration) Unclassified

Volume 4 of this bibliography of 1955 literature consists of approximately 1500 references. Unlike volume 3 which incorporated earlier material which had not been included in preceding volumes, the present compilation omits earlier material in accord with a plan to confine all future volumes to the literature of the stated year and to collect all omitted items in a supplement to be published as the concluding volume of each series.

1447

Library of Congress. Science and Technology Div., Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY; AN ANNOTATED BIBLIOGRAPHY, VOLUME V, 1956 LITERATURE, by A. J. Jacobius, R. Kenk and others. 1962, 378p. incl. refs. (AFOSR-65-0853) (Sponsored jointly by Air Force [Office of Scientific Research under ISSA 63-3], Federal Aviation Agency, and National Aeronautics and Space Administration) Unclassified

This bibliography is part of a continuing series of literature searches in the field of aerospace medicine and biology. It contains approximately 1500 abstracts of 1956 literature, including journal articles, reports, and monographs, arranged by subject category. An author index, subject index, and corporate author index are included.

1448

Liège U. (Belgium).

RESEARCH IN HYPERBOLIC DIFFERENTIAL EQUATIONS, by F. J. Bureau. Final rept. Mar. 15, 1962, 7p. (AFOSR-2704) (AF 61(052)86) Unclassified

The specific objective of the proposed research was to conduct a program of investigation on the existence and properties of solutions of elliptic and hyperbolic, linear and non-linear, partial differential equations.

In particular, a group of researchers was centered on the initial value problem (problem of Cauchy) for linear totally hyperbolic partial differential equations. The object of the second group of researchers was to determine the asymptotic behavior of the spectral functions associated with a boundary value problem for totally hyperbolic equations in several independent variables. The final result concerning this spectral function depends on a certain Tauberian theorem whose first form was finally completed in order to give a precise estimate of the remainder term. The main result is that the asymptotic behavior of the spectral function depends only on the values of the coefficients of L_x at the point x and is independent of the boundary conditions. The same method was used to investigate the asymptotic behavior of the spectral matrix of the operator of elasticity. A comprehensive research program on partial differential equations was also initiated with the view of obtaining new results or new methods for known results. It appears that the properties of the finite part and of the logarithmic part of certain divergent integrals are basic for an adequate study of the problems considered.

1449

Lockheed Aircraft Corp. [Missiles and Space Div.] Sunnyvale, Calif.

RESPONSE OF A BURNING SOLID TO SMALL-AMPLITUDE PRESSURE OSCILLATIONS, by F. A. Williams. [1962] [14]p. incl. diagrs. table, refs. [AF 49(638)-412] Unclassified

Published in Jour. Appl. Phys., v. 33: 3153-3166, Nov. 1962.

The acoustic response for waves normally incident upon a burning surface region is analyzed. The combustion process involves heat conduction within the solid, an irreversible surface pyrolysis process, and a distributed gas-phase reaction zone with conduction and diffusion. Linear differential equations determining the acoustic response are derived for arbitrary frequencies and simplified to a single second-order equation for the case in which the frequency is small compared to the reciprocal of a characteristic gaseous reaction time. An approximate analytical solution to this last equation, valid when the over-all activation energy for the gaseous reaction is large, is shown to yield a simple formula for the admittance, which determines the acoustic response. This admittance formula implies that sound waves are attenuated at low frequencies and, in most cases, amplified only when the frequency approaches the reciprocal of the reaction time. In particular, it is inferred that a pure solid ammonium perchlorate deflagration will not amplify acoustic vibrations, and therefore, presumably, will not experience oscillatory combustion. (Contractor's abstract)

1450

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

FIELDS SATISFYING THE ASYMPTOTIC CONDITION, by R. F. Streater. [1962] [13]p. incl. refs. (AFOSR-3713) (AF EOAR-61-87) Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 274-286, July 16, 1962.

It is proved that a necessary and sufficient condition that a local current should be the current of a local field satisfying the asymptotic condition is that the time-ordered products of the current should have the same 1-particle singularities as come from all Feynman graphs which can be disconnected by cutting 1 internal line. It is shown that a field theory with a unique vacuum and 1-particle state, and satisfying the asymptotic condition, is defined by its set of reduced Wightman functions (whose spectra begin at the threshold of the 2-particle continuum). The problem of ensuring that the space of states has a positive definite metric is not solved.

1451

London U. Imperial Coll. of Science and Tech. (Gt. Brit.).

MASS-DIFFERENCE AND STRANGENESS EFFECTS IN HYPERON-NUCLEON SCATTERING, by P. A. Protopapadakis. [1962] [6]p. incl. refs. (AFOSR-4415) (AF EOAR-62-87) AD 295973 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 134-139, Oct. 1, 1962.

The formal features of a partial wave dispersion theoretical treatment of hyperon-nucleon scattering are discussed, from the standpoint of their differences with respect to nucleon-nucleon scattering.

1452

London U. Imperial Coll. of Science and Tech. (Gt. Brit.).

DISPERSION THEORY OF THE DEUTERON FORM FACTOR AND ELASTIC e-d SCATTERING, by H. F. Jones. [1962] [13]p. incl. diagrs. table, refs. (AFOSR-J143) (AF EOAR-62-87) AD 400090 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 790-802, Nov. 16, 1962.

The anomalous threshold discontinuities of the deuteron form factors are calculated by an extension of Cutkosky's method to the spinor case. The form factors are then evaluated in a tail approximation and substituted into the single photon exchange term for elastic e-d scattering. The resulting expression is very similar to the Jankus formula, but shows that the usual modification $e \to eF_1^S$ should more correctly be

$e - eF^{S}_{ch}(1 - s/4m_d^2)^{-1}$. The bare form factors should also be multiplied by $(1 - s/4m_d^2)^{-1}$. Small angle scattering is re-analyzed with the new formula; the changes are largely masked by the experimental uncertainties, but result in a small increase in the neutron form factor F^{n}_{1}.

1453

London U. Imperial Coll. of Science and Tech. (Gt. Brit.).

PRODUCTION OF STRANGE PARTICLES IN PROTON-NEUTRON COLLISIONS, by W. D. Curtis. [1962] [14]p. incl. diagrs. tables, refs. (AFOSR-J318) (AF EOAR -62-87) AD 408025 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 164-177, Jan. 1, 1963.

Strange particle production in proton-neutron collisions is calculated by means of the 1-pion exchange (O. P. E.) model for an incoming neutron with a kinetic energy of 3 gev in the laboratory frame. The calculation takes into account 2 Feynman diagrams and includes the interference term. Use is made of the Ferrari-Selleri cut-off function $C(\alpha, q^2)$ and these results are compared with those that do not take this into account. The lab. energy spectra of the outgoing nucleons are drawn for the 6 p n processes, and their total cross-sections evaluated. From these results the total cross-section values for the 4 corresponding p, p reactions are deduced and compared with their known experimental values at 2.85 gev. Good agreement is shown in 3 of these cases, but the theoretical result for the fourth one is somewhat small. (Contractor's abstract)

1454

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

CALCULATION OF THE YUKAWA COUPLING CONSTANT, by R. Delbourgo. [1962] [8]p. (AFOSR-J551) (AF EOAR-62-87) AD 407923 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 1431-1438, Mar. 16, 1963.

By expressing Feynman diagrams as dispersion integrals with a finite cut-off, one calculates to lowest order the renormalization constants Z_1, Z_2, Z_3, for a Yukawa coupling. By setting each Z equal to zero one obtains the approximate solutions $g^2/4\pi = O(30)$ and $\mu/m \leq 0.2$ with a cut-off of about 3 nucleon masses. (Contractor's abstract)

1455

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

T_{ab} AND T^{*}_{ba} AS OPPOSITE BOUNDARY VALUES, by M. A. Rashid and A. Syed. [1962] [5]p. (AFOSR-J552) (AF EOAR-62-87) AD 408597 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 107-111, Apr. 1, 1963.

Using generalized retarded operators, it is proved that the result that T_{ab} and T^{*}_{ba} are opposite boundary values of the same analytic function that holds in axiomatic theory even for the processes m → n.

1456

London U. Imperial Coll. of Science and Tech. (Gt. Brit.).

ELIMINATION OF THE BACKGROUND INTEGRAL IN THE REGGE FORMULA, by A. M. Kaufman. [1962] [12]p. (AFOSR-J966) (AF EOAR-62-87) AD 417147 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 804-815, Feb. 16, 1963.

It is shown that under conditions of boundedness of the S-matrix in the left 1/2-plane, the background integral in the Regge formula can be removed. Removal of the background integral forces the introduction of infinite number of fixed poles in addition to the Regge poles. This points out the basic nonremovability of the contribution of the background integral. (Contractor's abstract)

1457

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

BROKEN SYMMETRIES, by J. Goldstone, A. Salam, and S. Weinberg. [1962] [6]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-62-87] and Office of Naval Research) Unclassified

Published in Phys. Rev., v. 127: 965-970, Aug. 1, 1962.

Some proofs are presented of Goldstone's conjecture, that if there is continuous symmetry transformation under which the Langrangian is invariant, then either the vacuum state is also invariant under the transformation, or there must exist spinless particles of zero mass. (Contractor's abstract)

1458

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

THE $\bar{K}N$ RESONANCE AT THE $\bar{K}^*N$ THRESHOLD, by C. H. Chan. [1962] [19]p. incl. diagrs. refs. [AF EOAR-62-87] Unclassified

Published in Nuclear Phys., v. 39: 220-238, Dec. 1962.

Feldman, Matthews and Salam's damping theory of $\bar{K}^*$ production in $\bar{K}N$ collisions and its effect on the $\bar{K}N$ resonance at 1 gev/c are fully investigated. To make the calculation possible, we have assumed the $\bar{K}^*$-meson to be stable and taken the 1-pion-exchange as the only contribution to the left hand cut. It is found that a resonance can be produced in the $\bar{K}N$ system in the $D_{3/2}$, $I = 0$ state when $\bar{K}^*$ is taken as a vector meson.

1459

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

PROTON-ANTIPROTON ANNIHILATION INTO ELECTRONS AND MUONS, by K. J. Barnes. [1962] [8]p. incl. diagrs. refs. [AF EOAR-62-87] Unclassified

Published in Nuovo Cimento, Series X, v. 28: 284-291, Apr. 16, 1963.

A formula for the electromagnetic annihilation of a particle-antiparticle pair of spin 1/2 into another such pair is given in terms of covariant variables. This formula, which allows for the possibility of structure of both pairs, is then applied to the particular case of proton-antiproton annihilation into electron and muon pairs. (Contractor's abstract)

1460

London U. [Imperial Coll. of Science and Tech.] (Gt. Brit.).

REDUCTION OF S-MATRIX ELEMENTS, by A. Syed. [1962] [12]p. [AF EOAR-62-87] Unclassified

Published in Jour. Math. Phys., v. 4: 797-808, June 1963.

Expressions are obtained for the commutators of in- and out-fields with the generalized retarded operators of Burgoyne and Ruelle. These are then used to show that the matrix element $\langle p_1, \cdots, p_m \text{ out}/-p_{m+1}, \cdots, -p_r \text{ in} \rangle$, where $p \equiv (p_1, p_2, \cdots, p_n)$ is arbitrary, can be reduced in terms of retarded functions without using the assumption of stability of one-particle states.

1461

London U. Imperial Coll. of Science and Tech. (Gt. Brit.).

SPECULATIONS ON μ-MESON FORM FACTORS, by K. J. Barnes. [1962] [9]p. incl. diagrs. tables refs. [AF EOAR-62-87] Unclassified

Published in Nuovo Cimento, Series X, v. 27: 228-237, Jan. 1, 1963.

A formula for the elastic electromagnetic interaction of 2 spin-1/2 particles with structure is given in terms of covariant variables, and this formula is then used to calculate the differential cross-section for the scattering of μ + mesons by protons. An attempt is made to discover what evidence of any possible μ-meson structure can be obtained from such experiments, and some of the difficulties involved are discussed. (Contractor's abstract)

1462

London U. Inst. of Laryngology and Otology (Gt. Brit.).

THE STUDY OF THE MECHANISM OF TRANSFORMATION OF PHYSICAL ENERGY INTO NERVE ACTIVITY IN THE INTERNAL EAR, by F. C. Ormerod. Final technical rept. Mar. 1962, 15p. incl. refs. (AFOSR-2910) (AF 61(052)271) AD 293249 Unclassified

A very full investigation has been made into the carbohydrate metabolism in the ear of the pigeon. Experiments on the vestibule in pigeons have established the presence of acetylcholinesterase. Administration of nocuous chemical substances, alcohol, quinine, streptomycin and thiouracil has not been followed by any changes demonstrable by light microscopy. Rotatory, caloric and positional tests of the vestibular labyrinth have been carried out in man and animals under a variety of positions and conditions, and after the ingestion in man and the injection in animals of various chemical substances. Echolocation was studied, and the noise-emitting and receptor mechanism of certain moths and the direction finding procedures used by owls were investigated. The properties of ultrasonic vibrations were investigated. Anatomic and histologic preparations of the skulls and ears of a wide variety of small animals were made.

1463

London U. Inst. of Laryngology and Otology (Gt. Brit.).

CORRELATED ORIENTATIONS SOUNDS AND EAR MOVEMENTS OF HORSESHOE RATS, by J. D. Pye, M. Flinn and others. [1962] [4]p. incl. diagrs. (AFOSR-J208) (In cooperation with Harvard U., Cambridge, Mass. and Mass. Inst. of Tech., Lexington) (AF EOAR-61-40) AD 400179 Unclassified

Also published in Nature, v. 196: 1185-1188, Dec. 1962.

Horseshoe bats emit a buzz of rapidly repeated and

shortened orientation sounds when echo-locating objects at close range. Motion pictures and synchronized tape recordings were taken of this species, some at 768 frames/sec and others at 64 frames/sec. There was a close, though not perfect, correlation between the emission of the short pulses and the alternating movements of the ears. If these bats are deprived of the use of these muscles that move the pinnae, they compensate by nodding the head vigorously. A brief investigation of the muscles responsible for ear movements was undertaken. The speed of contraction of the superficial cervico-auricularis muscle when loaded with the pinna was tested with direct electrical stimulation. It was shown that the auricular muscles are capable of moving the pinna by separate contractions within the normal speed range of the active bat. Present results are compatible with the hypothesis that Rhinolophus is able to use the Doppler shifts which the moving ears impose on returning echoes of its own orientation sounds. (Contractor's abstract)

1464

London U. Coll. Dept. of Anatomy (Gt. Brit.).

THE LIMITS OF TRANSFER OF A LEARNED DISCRIMINATION TO FIGURES OF LARGER AND SMALLER SIZES, by J. R. Parriss and J. Z. Young. [1962] [18]p. incl. diagrs. tables. (AFOSR-J936) [AF EOAR-61-39] AD 415872 Unclassified

Also published in Zeitschr. verglichende Physiol., v. 45: 618-635, 1962.

The hypothesis was tested in Octopus that the capacity to transfer to figures of various sizes depends upon experience of different sizes of retinal image during training. During training to discriminate between vertical and horizontal rectangles, discrimination was always better for larger than for smaller figures. Rectangles 22 x 4.5 mm, when seen at 1000 mm, are near the limit of discrimination. Some groups of animals were given wide retinal experience. They were either allowed to approach the figures during training, or were trained in 3 fixed positions. Other groups were given limited retinal experience, being trained in one position and not allowed to move towards the figures. Transfer was found to be greater in the groups where the transfer figures were within retinal experience, especially for transfer downwards. The animals showed some capacity to recognize figures outside retinal experience larger than the training figure, when the training figure was small and at a distance. However, there was very little recognition of retinal images smaller than any seen during training. Octopuses trained with small figures a short distance away cannot recognize larger figures. As recorded in other species, transfer was always better to figures 2 and 4 times the size used in training than to half and a quarter the size used in training. Outside these limits transfer decreased rapidly.

1465

[London U. Coll. Dept. of Anatomy (Gt. Brit.)]

SIMULTANEOUS SHAPE DISCRIMINATION IN OCTOPUS AFTER REMOVAL OF THE VERTICAL LOBE, by W. R. A. Muntz, N. S. Sutherland, and J. Z. Young. [1962] [10]p. incl. tables, refs. (AFOSR-J937) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-61-39] and Office of Naval Research) Unclassified

Also published in Jour. Exper. Biol., v. 39: 557-566, Dec. 1962.

Octopuses from which the vertical or median superior frontal lobes had been removed were able to discriminate between objects shown simultaneously, although they could not distinguish them when shown successively. Discrimination by operated animals was always less accurate than by controls. A very difficult simultaneous discrimination could not be performed without the vertical lobes (although the same animal was able to make it before operation). A discrimination learned by the simultaneous method before operation continues to appear (though less accurately) after vertical lobe removal. The experiments therefore confirm previous evidence that the representations that ensure correct visual responses do not lie mainly in the vertical lobes, but elsewhere (probably in the optic lobes). The function of the vertical lobes is considered to be to stabilize and perhaps lower the level of tendency to attack.

1466

London U. Coll. Dept. of Anatomy (Gt. Brit.).

STUDIES ON THE RECEPTORS IN THE CEREBRAL VESICLE OF THE ASCIDIAN TADPOLE. I. THE OTOLITH, by P. N. Dilly. [1962] [6]p. incl. illus. diagr. (AFOSR-J939) [AF EOAR-61-39] AD 415867 Unclassified

Also published in Quart. Jour. Microscopic Sci., v. 103: 393-398, 1962.

Electron microscope observations of the gravity receptor of the tadpole larva of Ciona intestinalis show that the otolith is unicellular. The nucleus of the otolith persists for the entire life of the tadpole. The pigment mass of the otolith is intracellular, and it appears to be built up by fusion of granules. The otolith cell has a free part within the cavity of the cerebral vesicle, and a foot part which is contained within a mound of cells on the ventral wall of the cerebral vesicle. The junction between these 2 parts is probably the transducer region. The transducer region is a complex system of folded cell membrane. Distortion of this system during rotation of the tadpole while swimming probably evokes changes in the neurones which surround the foot process of the otolith cell. One of these neurones is connected to the cerebral ganglion by a process which may be an axon. Fibrils extend from the transducer region of the otolith cell to the basement membrane, and probably serve to resist distortion of the transducer region. The foot process of the otolith cell

is connected to the surrounding cells by specializations of the cell membrane similar to attachment plaques. The observations suggest that the otolith has been evolved from a cilium.

1467

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

d-ORBITALS IN COMPOUNDS OF SECOND-ROW ELEMENTS. I. SF_6, by D. P. Craig and C. Zauli. [1962] [8]p. incl. tables, refs. (AFOSR-J6) (AF 61(052)61) AD 400382 Unclassified

Also published in Jour. Chem. Phys., v. 37: 601-608, Aug. 1, 1962.

Optimum exponent values for 3s, 3p, and 3d orbitals of sulfur in SF_6 have been calculated in an electrostatic approximation. The sulfur electrons are perturbed by fluorine potentials appropriate to self-consistent field wave functions for the fluorine orbitals, and the energy minimized with respect to wave-function exponents. The optimum values are $k_{3s} = 2.0$, $k_{3p} = 1.6$, and $k_{3d} = 1.2$, corresponding to expansion of 3s and 3p orbitals, and contraction of 3d, compared with free-atom values. The values are remarkably stable to changes in valence-orbital configurations as between SF_6, $S^+F_6^-$, $S^{++}F_6^{--}$, and even $S^-F_6^+$. They are also little affected by change in hybridization at fluorine, and should therefore be suitable for use in the construction of molecular wave functions. Although the calculated energies include no exchange terms they are still of some interest since they suggest, for example, that the promotion energy to the configuration sp^3d^2 of sulfur (estimated to be 25-31 ev) can be compensated by the energy of molecule formation. (Contractor's abstract)

1468

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

d-ORBITALS IN COMPOUNDS OF SECOND-ROW ELEMENTS. II. COMPARISON OF H, C, F, AND Cl AS LIGANDS, by D. P. Craig and C. Zauli. [1962] [7]p. incl. diagrs. tables. (AFOSR-J10) (AF 61(052)61) AD 400387 Unclassified

Also published in Jour. Chem. Phys., v. 37: 609-615, Aug. 1, 1962.

Calculations have been made to contrast the effects of H, C, F, and Cl as ligands on loosely bound d orbitals of second-row elements. Sets of 1, 2 (at right angles), 4 (square), and 6 (octahedral) identical atoms are compared. The approximation is electrostatic, with the use of potentials derived from self-consistent field wave functions. The order of effectiveness is F > Cl > C >> H. The first 3 are more nearly equal in their perturbing power than expected from their electronegativities, and hydrogen is surprisingly ineffective. The conclusions lend themselves to some generalization to the conditions of binding in second-row elements. These are discussed, and some examples given. (Contractor's abstract)

1469

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART X. SUBSTRATE-ISOTOPE EFFECTS ON KINETICS AND PRODUCTS OF ACID REARRANGEMENT OF THE HYDRAZOBENZENES, by D. V. Banthorpe and E. D. Hughes. [1962] [6]p. incl. tables. (AFOSR-64-1554) [AF 61(052)66] AD 446117 Unclassified

Also published in Jour. Chem. Soc. (London), No. 654: 3308-3313, Sept. 1962.

Hydrazobenzene, its 4,4'-dideutero-derivatives, and a derivative C-deuterated everywhere except in 4,4'-positions, have been rearranged with acid in aqueous dioxan and in aqueous and anhydrous ethanol; and comparisons have been made of the rearrangement rates and product proportions. The products are benzidine 76-72%, and diphenyline 24-28%, the small variation depending on the solvent. Neither in para- nor in ortho-positions does deuteration make a detectable difference either to reaction rates or to product ratios. The aromatic proton losses are concluded to occur after the activation barrier for rearrangement has been surmounted, and after the mechanism has decisively branched towards the individual products. (Contractor's abstract)

1470

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART IX. SUBSTRATE-ISOTOPE EFFECTS ON KINETICS AND PRODUCTS OF ACID REARRANGEMENT OF 1,1'-HYDRAZONAPHTHALENE by D. V. Banthorpe, E. D. Hughes and others. [1962] [9]p. incl. tables, refs. (AFOSR-64-1809) [AF 61-(052)66] AD 449096 Unclassified

Also published in Jour. Chem. Soc. (London), No. 653: 3299-3308, Sept. 1962.

1,1'-Hydrazonaphthalene, as well as its 2,2'- and 4,4'-dideutero-derivatives, the preparation of which is described, have been rearranged with acid in 60% aqueous dioxan, and comparisons have been made of rearrangement rates and product proportions. The same hydrazo-compounds have been rearranged with acid in 95% aqueous ether-ethanol, and comparisons have been made of product proportions. In the conditions of these comparisons, 3 products alone are formed, the single 4,4'-ring-coupled product, naphthidine, and the pair of 2,2'-ring-coupled products, dinaphthyline, and its cyclised relative, dibenzocarbazole, all in substantial, easily measurable, amounts. In the dioxan solvent, neither 2-deuteration nor 4-deuteration affects the overall rate of rearrangement.

In both solvents, neither 2- nor 4-deuteration affects the ratio of 4,4'- to total 2,2'-ring-coupled products. In both solvents, 2-deuteration, but not 4-deuteration, does change the internal ratio of the two 2,2'-ring-coupled products, the shift being large, and in favor of the carbazole. (Contractor's abstract)

1471

London U. Coll. [Dept. of Physics] (Gt. Brit.).

SUBTRACTION CONSTANTS IN $\pi - \pi$ A N- $\bar{N}$ DISPERSION RELATION, by P. Menotti. [1962] [3]p. [AF 61-(052)468] Unclassified

Published in Nuovo Cimento, Series X, v. 23: 931-933, Mar. 1, 1962.

The author introduces a double subtraction in the dispersion relation for the helicity amplitude $f^{\circ}_{+}(t)$ in the reaction π-$\pi \rightarrow$ N-$\bar{N}$.

1472

London U. Coll. Dept. of Physics (Gt. Brit.).

PION-NUCLEON SCATTERING AND PION-PION INTERACTIONS, by J. Hamilton, P. Menotti and others. June 8, 1962 [94]p. incl. diagrs. tables, refs. (Technical note no. 5) (AFOSR-3382) (AF EOAR-62-3) AD 284995 Unclassified

Also published in Phys. Rev., v. 128: 1881-1907, Nov. 15, 1962.

The dispersion relations for π-N partial wave amplitudes are applied to s-wave and p-wave scattering data. The low energy behavior of the T = O, J = O and T = 1, J = 1 π-π scattering amplitudes is deduced, and the results are shown to be in agreement with other information on π-π scattering.

1473

London U. Coll. Dept. of Physics (Gt. Brit.).

PREDICTION OF PION PHASES, by D. Atkinson. June 20, 1962 [26]p. incl. diagrs. refs. (Technical note no. 6) (AFOSR-3547) (AF EOAR-62-3) AD 285521 Unclassified

Also published in Phys. Rev., v. 128: 1908-1915, Nov. 16, 1962.

A method of deducing the pion-pion phase shifts from the pion-nucleon phase shifts is developed. A predominantly attractive S-wave interaction is found. A resonant P-wave and an appreciable D-wave are also deduced. (Contractor's abstract)

1474

London U. Coll. Dept. of Physics (Gt. Brit.).

ANGULAR CORRELATIONS IN A BETA DECAY, by L. Egardt. July 4, 1962 [19]p. incl. diagrs. table. (Technical note no. 7) (AFOSR-3548) (AF EOAR-62-3) AD 285294 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 357-367, Jan. 16, 1963.

A current-current type of interaction is assumed with the conventional lepton current coupled to a general hyperon current involving 6 unknown form factors. The expression obtained for the electron proton angular correlation is to a large extent dominated by phase space and for reasonable assumptions about the form factors the angular distribution of electrons with respect to the proton momentum is always peaked in the backward direction. This also holds true for a scalar, pseudoscalar or a tensor interaction. Some comments are made on the effect of an intermediate particle.

1475

London U. Coll. Dept. of Physics (Gt. Brit.).

ANGULAR CORRELATIONS IN A BETA DECAY, by L. Egardt. Sept. 11, 1962 [19]p. incl. diagrs. table. (Technical note no. 10) (AFOSR-4062) (AF EOAR-62-3) AD 290702 Unclassified

For abstract see item no. 1474, Vol. VI.

1476

London U. Coll. Dept. of Physics (Gt. Brit.).

PION-PION INTERACTIONS IN THE STATES T = 0 AND T = 1, by T. D. Spearman. Aug. 29, 1962 [47]p. incl. diagrs. tables, refs. (Technical note no. 9) (AFOSR-4063) (AF EOAR-62-3) AD 290624 Unclassified

Also published in Phys. Rev., v. 129: 1847-1857, Feb. 15, 1963.

New dispersion relations are derived for the s-wave pion-nucleon scattering amplitudes. These relations are specifically chosen to facilitate the task of separating the 2-pion exchange term from the other effects contributing to low energy pion-nucleon scattering. In these equations the contribution from the unknown short range terms is markedly suppressed, a greater emphasis is placed on the experimentally better established very low energy pion-nucleon data, (in particular, on the scattering lengths), and in the contribution of the 2-pion exchange term, the lower energies are more heavily stressed. The terms due to the 2-pion exchange, which we isolate, are very clearly recognized by their characteristic energy dependences. The 2-pion exchange terms are analyzed in terms of the interaction between the 2 pions. The values obtained for these terms are made to yield information

about the phase-shifts for pion-pion scattering in the T = 1 and T = 0 states. In the T = 1 state the data are well fitted with a narrow resonance in the pion-pion system at 750 mev Taking the results of electron-nucleon scattering experiments in conjunction with the present data, the half-width of this resonance is found to lie between 40 and 60 mev, in agreement with the experimental data for the observed P-meson.

1477

London U. Coll. Dept. of Physics (Gt. Brit.).

ON THE Λ_{e3} DECAY, by L. Egardt. Aug. 29, 1962 [14]p. incl. diagrs. refs. (Technical note no. 8) (AFOSR-4064) (AF EOAR-62-3) AD 290625 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 368-375, Jan. 16, 1963.

Expressions for the proton spectrum are obtained under the assumption of a current-current interaction and for a scalar and tensor interaction. If the induced form factors are neglected and the V-A form factors are assumed to be constant, the spectrum yields useful information about the relative strength of the vector and axial vector current.

1478

London U. Coll. Dept. of Physics (Gt. Brit.).

RESEARCH IN HIGH ENERGY PHYSICS AND RELATED TOPICS, by J. Hamilton. Final rept. Oct. 1961-Oct. 1962. Nov. 27, 1962, 4p. (AFOSR-4400) (AF EOAR-62-3) AD 295975 Unclassified

Work on the application of dispersion relation techniques to pion-nucleon and nucleon-nucleon interactions is reviewed. Considerable work has also been done on the leptonic decays of hyperons. Among the topics discussed are pion-nucleon scattering, s-wave pion-nucleon scattering, p-wave pion-nucleon scattering, nucleon-nucleon interactions, and hyperon decay.

1479

London U. Coll. Dept. of Physics (Gt. Brit.).

SOME REMARKS ON THE Λ_{L3} DECAY. by L. Egardt. [1962] [2]p. incl. refs. [AF EOAR-62-3] Unclassified

Published in Nuovo Cimento, Series X, v 26: 200-201, Oct. 1, 1962

General formula for the proton-electron angular correlation and the proton spectrum is given. Electron distribution is peaked in the backward direction.

1480

Long Island Biological Assoc., Inc., Cold Spring Harbor, N. Y.

COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY. VOL. XXVI. CELLULAR REGULATORY MECHANISMS, Cold Spring Harbor, N. Y., June 4-12, 1961, ed. by L. Frisch. Cold Spring Harbor, Long Island Biological Assoc., Inc., 1961, 408p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-73, Atomic Energy Commission, National Institutes of Health, National Science Foundation, and Rockefeller Foundation) Unclassified

This symposium was devoted to the role of genetic material as an information code in protein synthesis and the mechanism of information transfer from DNA to the site of synthesis. Major attention was given to cellular mechanisms governing the rates of enzyme activity and enzyme synthesis. While most of the research presented dealt with microorganisms, the significance of these efforts in questions of normal and abnormal growth and development in multicellular forms is apparent.

1481

Long Island Biological Assoc., Inc., Cold Spring Harbor, N. Y.

BASIC MECHANISMS IN ANIMAL VIRUS BIOLOGY. 27TH COLD SPRING HARBOR SYMPOSIUM ON QUANTITATIVE BIOLOGY. Final summary rept. June 7-13, 1962 [6]p. (AFOSR-5108) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-276, Atomic Energy Commission, National Institutes of Health, National Science Foundation, and Rockefeller Foundation) AD 413871 Unclassified

Papers dealing with various aspects of animal virus biology were presented. One paper discussed virus structure from the viewpoint of the crystallographer. Two papers that were completely spontaneous resulted from the recognition that the field was infused with ideas for which there was no uniform nomenclature. A series of proposals for these ideas, as well as a system for grouping viruses according to recognized properties, were formulated. From several laboratories, there were papers applying the new concepts of molecular biology to diverse animal viruses. In some papers, the traditional question of the host-parent relationship was brought to the level of cell biology. Several papers were concerned with the mechanisms by which viral agents may induce tumors.

1482

Long Island Biological Assoc., Inc., Cold Spring Harbor, N. Y.

COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY: VOL. XXVII. BASIC MECHANISMS IN ANIMAL VIRUS BIOLOGY, Cold Spring Harbor, N. Y.,

June 7-13, 1962, ed. by L. Frisch. Cold Spring Harbor, Long Island Biological Assoc., Inc., 1962, iv. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-278. Atomic Energy Commission, National Institutes of Health, National Science Foundation, and Rockefeller Foundation) Unclassified

For abstract see item no. 1481, Vol. VI.

1483

Los Angeles State Coll. Dept. of Chemistry, Calif.

THE EFFECT OF CERTAIN VARIABLES ON THE ULTRASONIC CLEAVAGE OF PHENOL AND OF PYRIDINE, by D. L. Currell, G. Wilheim, and S. Nagy. [1962] [4]p. incl. tables, refs. (AFOSR-J781) (AF 49(639)471) AD 412978 Unclassified

Presented at Pacific Southwest Regional meeting of the Amer. Chem. Soc., Los Angeles, Calif., Dec. 1960.

Also published in Jour. Amer. Chem. Soc., v. 85: 127-130, Jan. 20, 1963.

The effect of pH and dissolved gases on the ultrasonic reaction of aqueous solutions of phenol and of pyridine to produce acetylene has been investigated. Phenol in alkaline solution and pyridine in acid solution are essentially unaffected by ultrasonic waves. The rate of production of acetylene is dependent upon the ratio of specific heats of the dissolved gases. The rate of the ultrasonic cleavage of the pyridine ring was shown to be independent of the surface tension of the reaction solution. The significance of these results is discussed in terms of possible mechanisms for the chemical effect of ultrasonic waves.

1484

Louisiana State U., Baton Rouge.

INTERVAL CLANS WITH NONDEGENERATE KERNEL, by R. C. Phillips. [1962] [5]p. (AF 18(603)89) Unclassified

Published in Proc. Amer. Math. Soc., v. 14: 396-400, June 1963.

Let S be a compact, connected semigroup with identity (i.e., a clan) whose underlying space is an ordered space (homeomorphic to an interval of real numbers). The author calls such semigroups interval clans. Suppose further that the kernel K is proper and nondegenerate. From known results, K consists of either all left zeros or all right zeros. It is assumed that these are all right zeros; in the case of left zeros, the result is analogous. The author characterizes such semigroups in terms of an interval semigroup with zero S' and a mapping h as follows. Let u denote the identity, d the other point, and 0 the zero of S'. Then there exists an idempotent $e \in (0,u]$ such that $de = 0$, and h is a continuous mapping of $[0,u]$ on a compact connected ordered space inducing a congruence on the standard thread (= I-semigroup $[0,e]$. The construction for retrieving the semigroups S from S' and h requires a number of defining relations which are too complicated to reproduce here. The semigroup S' is simply the Rees quotient of S. Although the paper considers only separable spaces, the proofs seem not to depend on the separability. (Math. Rev. abstract)

1485

Louvain U. (Belgium).

PRESSURE DEPENDENCE OF THE RESISTIVITY OF GERMANIUM, by A. Van Itterbeek, O. Verbeke, and F. Theeuwes. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0767) (AF EOAR-63-40) AD 436488 Unclassified

Also published in Physica, v. 29: 757-763, June 1963.

The specific resistivity of a germanium n-type monocrystal of high resistivity (76 ohm-cm at 15°C has been measured as a function of pressure and temperature. Calculations are carried out on the pressure and temperature dependence of the intrinsic energy gap and electron mobility. The pressure dependence has been measured with hydrostatic pressures upto 1000 km/cm^2 in a temperature range of 328.8°K to 174°K. Measurements of the specific resistivity as a function of temperature were carried out down to liquid hydrogen temperatures.

1486

[Louvain U.] (Belgium).

A PHASE-SELECTIVE X-Y-RECORDER FOR MAGNETIC RESONANCE EXPERIMENTS, by L. Van Gerven, A. Van Itterbeek, and L. Stals. [1962] [3]p. incl. illus. (AFOSR-64-2531) [AF EOAR-63-40] Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962) New York, Academic Press, v. 2: 684-686, 1963.

This note briefly describes a phase-selecting synchronous detecting X-Y recorder for differential recording of weak magnetic resonance signals. An electrodynamical wattmeter is used as the phase-selective element.

1487

[Louvain U.] (Belgium).

LOW FIELD EPR MEASUREMENTS IN DPPH AT LOW TEMPERATURES, by L. Van Gerven, A. Van Itterbeek, and L. De Laet. [1962] [14]p. incl. illus. diagrs. tables. (AFOSR-64-2532) [AF EOAR-63-40] Unclassified

Also published in Paramagnetic Resonance, Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 905-918, 1963.

The g-factor, the line width and the relaxation time of DPPH have been measured at 28 MHz between liquid helium temperatures and room temperature. At very low temperatures, the g-factor displays a peculiar temperature dependence, which is possibly due to uncertainties in the demagnetization corrections. The shape of the DPPH absorption lines has been investigated by means of graphical comparison. In the whole temperature range they display a generalized Lorentzian shape. In the whole temperature range, the line width values are rather low, compared to those in the literature. The line width increases sharply between 50° and 20°K, in agreement with Singer's and the authors' previous measurements. Furthermore, a maximum in the line width vs temperature curve is found around 10°K. Using the dependence of the line width on H_1, preliminary and rough measurements have been made of the relaxation time between 1.7° and 300°K. (Contractor's abstract, modified)

1488

Louvain U. Dept. of Applied Mechanics (Belgium).

DYNAMIC BEHAVIOR OF PLATES UNDER THERMAL STRESS, by F. Buckens. Mar. 1962 [93]p. incl. diagrs. refs. (Technical rept. no 1) (AFOSR-3195) (AF 61(052)499) AD 278431 Unclassified

The effect of nonuniform thermal stress on vibrational behavior of plates is studied, first for a flat, then for a buckled plate (including the case of initial imperfections). The effect of uniform initial stress on wave propagation is considered, phase and group velocities being computed and approximated in function of wave number and stress. The experiments agree with theory as far as order of magnitude is concerned.

1489

Louvain U. Lab. for Inorganic and Analytical Chemistry (Belgium).

KINETICS OF THE PROPYLENE-OXYGEN FLAME REACTION, by R. Burke, F. Dewael and A. van Tiggelen. [1962] [5]p. incl diagrs. tables. (AFOSR-J648) (AF EOAR-62-65) AD 413632 Unclassified

Also published in Combustion and Flame, v. 7: 83-88, Mar. 1963.

Flame propagation velocities and temperatures have been measured in propylene-oxygen mixtures at different mixture strengths and varying dilutions with nitrogen. An activation energy of 40 kcal and a mean molecular weight of chain carriers of 32 can be derived from these measurements. The reaction mechanism is discussed.

1490

Louvain U. [Lab. for Inorganic and Analytical Chemistry (Belgium).

A KINETIC STUDY OF HYDROCARBON-OXYGEN-NITROGEN FLAME SYSTEMS AND MOLECULAR WEIGHTS OF CHAIN CARRIERS, by W. E. Falconer and A. van Tiggelen. [1962] [14]p. incl. diagrs. tables, refs. (AFOSR-J1014) [AF EOAR-63-42] Unclassified

Also published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 689-702.

The over-all activation energy (E_T) of the branching process and the mean molecular weight (M) of the chain carriers have been derived for flames of n-butane, isobutane, and neopentane. The results are respectively: n-butane: M = 23; E_T = 33 kcal; isobutane: M = 24; E_T = 31 kcal; and neopentane: M = 28; E_T = 38 kcal. These results are compared to analogous data obtained previously with other hydrocarbons and an interesting relation is observed between the bond energy CH and the activation energy of the branching process at least for saturated hydrocarbon compounds. Furthermore the rather low value of the mean molecular weight of the chain carriers constitutes an argument in favor of a rapid destruction of the alkyl radicals in their reaction with molecular oxygen; so peroxy radicals persist at the higher temperatures of the flame as compared to the temperature in slow oxidations. (Contractor's abstract, modified)

1491

Lund U. Dept. of Pharmacology (Sweden).

RESEARCH ON EFFECTS OF ACETYLCHOLINE ON THE MAMMALIAN MOTOR END-PLATE, by S. Thesleff. Final technical rept. Aug. 25, 1962 [5]p. incl. refs. (AFOSR-3479) (AF 61(052)108) AD 284909 Unclassified

Investigations of the electrophysiological properties of the mammalian motor end-plate reveal: (1) Prolonged or intermittent application of acetylcholine desensitizes the chemoreceptors of the motor end-plate, (2) The motor nerve controls the size of the chemosensitive surface in muscle fiber, presumably through the release of a chemical mediator, and (3) The chemical sensitivity of end-plate receptors in muscles from patients with myasthenia gravis is normal, suggesting that the neuromuscular defect in this disease is of prejunctional origin. (Contractor's abstract)

1492

Lund U. Dept. of Pharmacology (Sweden).

NERVOUS CONTROL OF CHEMOSENSITIVITY IN MUSCLE, by S. Thesleff. [1961] [12]p. incl. illus. diagrs. tables, refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)106], Muscular Dystrophy Associations of America, Inc., and Public Health Service) Unclassified

Published in Ann. New York Acad. Sci., v. 94: 535-548, Sept. 8, 1961.

Experiments on isolated mammalian skeletal muscle by electrical micromethods indicated that muscle fibers have a high uniform sensitivity to acetylcholine (ACH) and that upon innervation, the chemosensitive area decreases in size until it covers only the end-plate region. According to this view, the motor nerve has 2 functions: (1) to initiate mechanical activity in muscle, and (2) to control the size of its chemo-receptor surface. Since inactivity cannot explain the global chemosensitivity of denervated muscle fibers, it is assumed that lack of some chemical agent released by the nerve is responsible for the extension of the receptor surface.

1493

Lund U. Dept. of Pharmacology (Sweden).

IDEAS REGARDING RECEPTOR "DESENSITIZATION" AT THE MOTOR END-PLATE, by D. Elmqvist and S. Thesleff. [1962] [6]p. incl. illus. refs. (AFOSR-J389) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-62-28] and Muscular Dystrophy Associations of America) AD 408749 Unclassified

Also published in Rev. Canad. Biol., v. 21: 229-234, 1962.

A description is given of the process by which depolarizing drugs render the chemoreceptors of the motor end-plate refractory to chemical stimulation. Evidence is presented for and against the possibility that receptor desensitization by acetylcholine is one of the factors limiting the rate at which impulses propagate across the neuromuscular junction. The mechanism of receptor desensitization is unknown, but current theories regarding this process are presented.

1494

Lund U. Dept. of Physics (Sweden).

THE RELATIVE ABUNDANCE OF NUCLEI HEAVIER THAN LITHIUM IN PRIMARY COSMIC RADIATION, by K. Kristiansson, O. Mathiesen and A. Stenman. June 1962 [48]p. incl. diagrs. tables, refs. (AFOSR-3177) (AF EOAR-61-37) AD 282243 Unclassified

Also published in Arkiv Fysik, v. 23: 479-504, 1963. (AFOSR-3177)

The relative abundance of nuclei heavier than lithium in primary cosmic radiation was investigated. Photometric measurements were made on 362 tracks of heavy primary particles ($Z > 3$), which were found in an emulsion stack exposed over Texas at 41° geomagnetic latitude. The measurements have been corrected for different emulsion effects. Results of observations are presented. (Contractor's abstract)

1495

Lund U. [Dept. of Physics] (Sweden).

PRIMARY COSMIC RADIATION AND VERY HIGH ENERGY INTERACTIONS, by S. von Friesen. Administrative rept. no. 1, June 1-Nov. 30, 1962, 3p. (AFOSR-4815) (AF EOAR-62-71) Unclassified

Cosmic ray particles undergoing collisions with emulsion nuclei are being used in an analysis of nucleus-nucleus collisions. The analysis involves determination of the nature of the secondary particles, their energy and angular distribution. A procedure for measuring the charge of low-energetic heavy particles stopping in the emulsion is being tested. For this, an instrument which registers the profile of the tracks as a function of residual range has been constructed. A comparative study of the determination of particle charge by the integral blob length method as given by Barkas and a photometric method already being used in this laboratory is being made. A theoretical calculation has been performed of the spectra of the iron group with different assumptions about the acceleration mechanism, and the experimental spectrum has been compared with the calculated distribution. Work on the tracing of tracks found in one of the stacks exposed at Guam in 1959 is continuing.

1496

Lund U. Thermochemistry Lab. (Sweden).

THERMOCHEMISTRY OF SELECTED RADICAL RECOMBINATION REACTIONS, by S. Sunner. Final rept. Jan. 15, 1962, 10p. incl. refs. (AFOSR-2237) (AF 61(052)46) AD 274252 Unclassified

The photolysis of primary or secondary aliphatic disulfides in an organic matrix at 77°K quantitatively leads to the reaction $R_1R_2CHSSCHR_1R_2 \rightarrow R_1R_2C = S + HSCHR_1R_2$. Strong evidence is presented for the formation of stabilized thionyl radicals when a thiol is photolyzed. A few other compounds were studied strengthening the view that 2 fairly large radicals cannot simultaneously be formed and separately trapped in the system studied. Thus, one of the basic difficulties cannot be overcome in developing a method for the determination of radical recombination energies by warming up a solid solution of trapped, identical radicals, generated in situ. This statement should be valid in dealing with simple, not highly resonance-stabilized molecules. (Contractor's abstract)

1497

Lund U. Thermochemistry Lab. (Sweden).

A STUDY ON CONTRACTION, RELATIVE VISCOSITY AND MELTING CURVES OF SOME GLASS-FORMING HYDROCARBON MIXTURES, by K. Rosengren. Jan. 15, 1962 [9]p. incl. diagrs. table. (Technical note no. 7) (AFOSR-2327, pt. 1) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)-46, Swedish Natural Research Council, and Swedish Technical Research Council) AD 274160 Unclassified

Also published in Acta Chem. Scand., v. 16: 1421-1425, 1962.

The contraction, relative viscosity and melting curves have been studied for a number of hydrocarbon mixtures that form glassy states upon freezing at 77°K. The commonly used iso-pentane - 3-methyl pentane glasses as well as 3 new mixtures have been studied. The very smooth curves obtained for the iso-pentane - 3-methyl pentane glasses studied conclusively prove the absence of a microcrystalline structure, which might undergo phase transformation below 150°K. (Contractor's abstract, modified)

1498

Lund U. Thermochemistry Lab. (Sweden).

SOME NEW GLASS-FORMING HYDROCARBON MIXTURES, by K. Rosengren and S. Sunner. Jan. 15, 1962 [4]p. (Technical note no. 8) (AFOSR-2327, pt. 2) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)46, Swedish Natural Research Council, and Swedish Technical Research Council) AD 274160 Unclassified

Also published in Acta Chem. Scand., v. 16: 5[illegible], 1962.

Binary and ternary mixtures of hydrocarbons have been tested on their ability to form transparent glasses at liquid nitrogen temperature. Three parts of n-pentane and 8 parts of neo-hexane gave a stable glass, considered to be more inert towards radical attack than previously known glass-forming mixtures, which all contain hydrocarbons with tertiary carbon atoms. (Contractor's abstract)

1499

Lund U. Thermochemistry Lab. (Sweden).

A SYSTEMATIC STUDY OF THE PHOTOLYSIS OF SOME DIALKYL DISULFIDES IN A RIGID GLASS AT 77°K, by K. Rosengren. Jan. 15, 1962 [28]p. incl. diagrs. tables, refs. (Technical note no. 9) (AFOSR-2327, pt. 3) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)46, Swedish Natural Research Council, and Swedish Technical Research Council) AD 274160 Unclassified

Also published in Acta Chem. Scand., v. 16: 1401-1417, 1962.

A number of primary, secondary and tertiary aliphatic disulfides have been photolyzed in a hydrocarbon matrix at 77°K using super high-pressure mercury lamps together with appropriate filter. The spectral changes have been recorded and the reaction products, obtained after warm-up, have been identified using gas-liquid chromatography. All primary and secondary disulfides (except Me_2S_2) behave in an analogous stoichiometrically simple way (in contrast to tertiary butyldisulfide). Strong evidence is presented for the view that the only detectable overall reaction occurring during photolysis is $R_1R_2CHSSCHR_1R_2 \rightarrow R_1R_2C{=}S + HSCHR_1R_2$. The presence of both reaction products has been established. The spectral changes during the photolysis of dimethyl disulfide are only initially analogous to those of the other primary disulfides. Upon prolonged irradiation unknown reactions occur, leading to the formation of carbonomonosulfide, among other products. (Contractor's abstract)

1500

Lund U. Thermochemistry Lab. (Sweden).

THE PHOTOLYSIS OF ALKANETHIOLS IN A RIGID GLASS AT 77°K WITH THE POSSIBLE FORMATION OF THIYL RADICALS, by K. Rosengren. Jan. 15, 1962 [6]p. incl. diagr. (Technical note no. 10) (AFOSR-2327, pt. 4) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)46, Swedish Natural Research Council, and Swedish Technical Research Council) AD 274160 Unclassified

Also published in Acta Chem. Scand., v. 16: 1418-1420, 1962.

The photolysis of diethyl-, di-isopropyl-, and di-normal-butyl disulfide in an organic matrix at 77°K leads to the formation of a rather sharp and fairly stable absorption peak at about 25 kc/cm. After warming to room temperature, considerable quantities of disulfide were found in the solution. From this and additional experimental evidence, it is concluded that this peak best can be assigned to the thiyl radical. (Contractor's abstract)

1501

Lund U. Thermochemistry Lab. (Sweden).

THE PHOTOLYSIS OF IODINE, ETHYL IODIDE AND HYDROGEN IODIDE IN A RIGID GLASS AT 77°K by D. Timm. Jan. 15, 1962 [13]p. incl. diagrs. refs. (Technical note no. 11) (AFOSR-2327, pt. 5) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)46, Swedish Natural Research Council, and Swedish Technical Research Council) AD 274160 Unclassified

Also published in Acta Chem. Scand., v. 16: 1455-1462, 1962.

It has been found that the photolysis of iodine in a hydrocarbon matrix at 77°K does not lead to the formation

of iodine atoms. That the photolysis of ethyl iodide depends on the viscosity of the matrix has been confirmed and spectral characteristics of intermediates have been recorded. Identical characteristics were found when HI was photolyzed and it has been shown that h_3 is not invcived. (Contractor's abstract)

1502

Lund U. Ther ochemistry Lab. (Sweden).

ELECTRONIC ABSORPTION SPECTRA OF UNCONJUGATED ALKYL THIALS AND THIONES, by K. Rosengren. Apr. 3, 1962 [13]p. incl. diagrs. table, refs. (Technical note no. 12) (AFOSR-2705) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)46, Swedish Natural Science Research Council, and Swedish Technical Research Council) AD 280979 Unclassified

Also published in Acta Chem. Scand., v. 16: 2284-2292, 1962.

The electronic spectra of a number of simple aliphatic thials and thiones have been evaluated. The C=S compounds were obtained together with the corresponding thiols by photolysis of disulfides in hydrocarbon glasses at 77°K. Besides the previously known absorption in the visible region ($n \rightarrow \pi^X$ transition, 2 peaks were recorded in the far ultraviolet, one of which was seen only at room temperature. By comparison with analogous oxygen compounds, the 2 peaks were attributed to $n \rightarrow \sigma^X$ and $\pi \rightarrow \pi^X$ transitions, respectively, the latter, disappearing at 77°K, occurring from a vibrationally excited level. When the solutions were stored at room temperature, the intensity of the thiocarbonyl absorption gradually disappeared. For ethanethial, the disappearance was shown to correspond to a simultaneous formation of the trimer, 2,4,6-trimethyl trithiane. (Contractor's abstract)

1503

Lund U. Thermochemistry Lab. (Sweden).

PHOTOLYSIS OF DIALKYL DISULFIDES IN AN ORGANIC MATRIX AT 77°K (Abstract), by K. Rosengren. [1962] [2]p. (AF 61(052)46) Unclassified

Also published in Bull. Soc. C' 'n. Belg., v. 71: 855-856, Nov.-Dec. 1962.

A number of disulfides $(R_1R_2CHS)_2$, where R_1 = Alkyl and R_2 = Alkyl or H, have been photolyzed in a hydrocarbon matrix at 77°K using high-pressure mercury lamps together with appropriate filters. The spectral changes have been recorded and the reaction products, obtained after warm-up, have been identified. It has been postulated that the only detectable reaction occurring is $R_1R_2CHSSCHR_1R_2 \rightarrow R_1R_2C{=}S + HSCHR_1R_2$. Some of the main facts supporting this view are the following: (1) During photolysis of all primary and secondary disulfides the disulfide maximum at 40 kc cm^{-1} diminished, and absorption peak grew up in the region 44-45 kc cm^{-1} and a well-defined isobestic point was recorded; (2) With more concentrated solutions a faint red color appeared, peak maximum at about 19.5 kc cm^{-1}; (3) When the photolyzed samples were analyzed using gas-liquid-chromatography (GLC) mercaptan was found in amounts varying with the time of photolysis; and (4) Using GLC it was also demonstrated that photolysis at 77°K of a solution containing 2 different disulfides gave no mixed disulfide.

1504

Lyons U. [Dept. of Physiology] (France).

[RESEARCH ON THE NERVOUS STRUCTURES AND THE MECHANISMS RESPONSIBLE FOR THE DIFFERENT PHASES OF PHYSIOLOGICAL SLEEP] Recherches sur les structures nerveuses et les mecanismes reponsables des differentes phases du sommeil physiologique, by M. Jouvet. [1962] [2]p. incl. illus. diagrs. table, refs. (AFOSR-4179) (AF 61(052)109) Unclassified

Also published in Arch. Ital. Biol., v. 100: 125-206, Mar. 1962.

The results of this paper support the idea that 2 structures are responsible for the different phases of sleep. It revealed, on one hand that necessary role of the neocortex in the appeance of the synchronization phenomenon in sleep and on the other hand, the hypnotic system situated at the pontine reticular formation in relationship with the bordering system which is responsible for the period of rapid cortical activity during sleep. In the first part of the report, an electroencephalographic analysis of the different phases of physiological sleep in cats is presented. The second chapter deals with the threshold of wakefulness. The third concerns the different phases of sleep induced by stimulation. The fourth section is dedicated to evoked response during sleep, and the final chapter discusses the different effects of a variety of drugs.

1505

Lyons U. Dept. of Physiology (France).

RESEARCH ON THE NEUROPHYSIOLOGICAL MECHANISMS OF SLEEP, by M. Jouvet. Final technical rept. Jan.-Dec. 1961. May 1962, 24p. incl. refs. (AFOSR-2886) (AF 61(052)472) AD 288435 Unclassified

Investigations on new-born kittens nave shown that the rhombencephalic phase of sleep is the first pattern of behavioral sleep observed after birth and that the fast cortical activity during sleep precedes for some days the appearance of the fast cortical activity during arousal. Polygraphic recordings of EEG and EMG of the neck muscles have shown the periodical appearance of a regular theta cortical activity with a total decrease of muscular tonus, during behavioral sleep. These periods are analogous to the rhombencephalic sleep in the cat. Injection of sodium-γ-hydroxybutyrate and

sodium-γ-butyrolacton induces a sleep like state in normal cats which is different from physiological sleep. In decorticate cats however, these drugs may induce rhombencephalic sleep.

1506

Lyons U. [Dept. of Physiology] (France).

[POLYGRAPHIC STUDY OF SLEEP IN THE LAMB] Etude polygraphique du sommeil chez l'agneau, by D. Jouvet and J. L. Valats. [1962] [4]p. incl. diagrs. (AFOSR-J343) (AF 61(052)472) Unclassified

Also published in Compt. Rend. Séances Soc. Biol., v. 156: 1411-1414, June 25, 1962.

Results show that the 2 phases of sleep observed in other mammals are the same as those observed in the young ruminants. There is a decrease of the rhombencephalic phase of sleep at the time of onset of chewing. This lowering of the rhombencephalic phase of sleep can be due to a number of factors adding to the maturation of the nervous system.

1507

Lyons U. [Dept. of Physiology] (France).

[STUDY OF OCULAR MOVEMENTS OBSERVED IN MAN DURING AWAKENING AND SLEEP] Etude des mouvements oculaires observés chez l'Homme au cours de la veille et du sommeil, by M. Jeannerod and J. Mouret. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-J344) (AF 61(052)472) Unclassified

Also published in Compt. Rend. Séances Soc. Biol., v. 156: 1407-1410, June 25, 1962.

Eye movements in man are recorded during wakefulness and during sleep. During wakefulness, eye movements correspond to an angular speed of 125°C/sec. During the rhombencephalic phase of sleep, the ocular movements registered have an angular speed of 73°/sec. Results are analyzed statistically and are presented in tabular form.

1508

Lyons U. [Dept. of Physiology] (France).

[BEGINNING OF LACTASE SECRETION IN THE RABBIT BY INJECTION OF 5-HYDROXYTRYPTAMINE IN THE REGION OF THE HYPOTHALAMUS] Déclenchment de la sécretion lactee, chez la Lapine, par injection de 5-hydroxytryptamine dans la région de l'hypothalamus, by R. Kehl, J. C. Czyba, and others. [1962] [2]p. [AF 61(052)472] Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 156: 1414-1415, June 25, 1962.

The administration of 5-hydroxytryptamine at the level of the hypothalamus is capable of bringing about lactase secretion in the rabbit in the same way that sub-cutaneous injections of reserpine do.

Lyman Lab. of Physics, Cambridge, Mass.
see Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

1509

McMaster U. Hamilton Coll., Ont. (Canada).

OXIDATION OF METALS AND ALLOYS, by W. W. Smeltzer. Final rept. Oct. 31, 1959-Oct. 31, 1961. Jan. 20, 1962, 5p. incl. table. (AFOSR-2197) (AF 49-(638)734) Unclassified

A summary of research conducted on the oxidation of metals and alloys is presented. This includes studying the quantitative oxidation rate on metals and alloys important as potential aircraft and missile structural materials and analyzing for the diffusion processes of oxygen in the surface oxide and metal substrate during oxidation of metals in Periodic Subgroup IVB (titanium, zirconium and hafnium) and iron.

1510

McMaster U. Hamilton Coll., Ont. (Canada).

THE HIGH-TEMPERATURE OXIDATION KINETICS OF ZIRCONIUM, by K. H. Akram and W. W. Smeltzer. [1962] [17]p. incl. illus. diagrs. tables, refs. (AFOSR-3559) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)734 and Defence Research Board of Canada) AD 612238 Unclassified

Also published in Canad. Metall. Quart., v. 1: 51-57, July-Sept. 1962.

An investigation of the parabolic-linear oxidation of zirconium at 800° and 850°C is reported. It was found that irrespective of the oxygen concentration in the metal substrate, parabolic kinetics represent the growth of the initial compact oxide scale while linear kinetics represent the later stages of growth. Metallographic observations indicated a transition from a compact to compact plus porous oxide scale. Accompanying hardness measurements demonstrated that oxygen penetrated into the metal via a steady concentration profile during linear oxidation. An exponential solution of the diffusion equation fitted to the concentration profile gave evaluations of the oxygen diffusion constant in the metal which are in good agreement with such evaluations from diffusion experiments. Several features of the oxidation kinetics of zirconium and titanium were correlated as further elucidation of the properties of metals in Periodic Subgroup IVB.

1511

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-3112) (Also bound with its AFOSR-J1356; AD 432718) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-108 and Defence Research Board of Canada) Unclassified

Also published in Acta. Metall., v. 9: 880-885, Sept. 1961.

For abstract see item no. 1143, Vol. IV.

1512

McMaster U. Hamilton Coll., Ont. (Canada).

CORROSION OF IRON BASE ALLOYS AT HIGH-TEMPERATURES, by W. W. Smeltzer. [1962] [6]p. incl. illus. diagrs. refs. (AFOSR-J106) (AF AFOSR-61-108) AD 400425 Unclassified

Presented at Annual general meeting of the Canad. Inst. Mining and Metall., Ottawa, Ont., Apr. 1962.

Also published in Canad. Mining and Metall. Bull., v. 55: 759-764, Dec. 1962.

Also published in Trans. Canad. Inst. Mining and Metall., v. 65: 371-376, Dec. 1962.

The utilization of alloys in metallurgical dust collection systems is commonly determined by their resistance to the attack of corrosive atmospheres. The steels developed to meet the trends toward higher operating temperatures fall within the ferritic chromium and the austenitic chromium-nickel classifications. This paper presents a survey of the principles governing the corrosion resistance of these alloys in oxidizing atmospheres, and reviews the corrosion mechanisms which contribute to the deterioration of this resistance at high temperatures.

1513

McMaster U. Hamilton Coll., Ont. (Canada).

THE EVAPORATION OF IRON-CHROMIUM ALLOYS CONTAINING 5 AND 25 PER CENT CHROMIUM IN THE TEMPERATURE RANGE 900°—1080°C, by L. A. Morris and W. W. Smeltzer. [1962] [5]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1229) (AF AFOSR-61-108) AD 442854 Unclassified

Presented at meeting of the Electrochem. Soc., Boston, Mass., Sept. 16-20, 1962.

Also published in Jour. Electrochem. Soc., v. 110: 997-1001, Sept. 1963.

An investigation is reported on the evaporation and thermal etching of iron alloys containing 5 and 25% chromium in the temperature range 900°—1080°C under a vacuum of 10^{-6} mm Hg. Evaporation proceeded by constant rates for exposures extending several hours: the activation energies were 94.3 and 93.7 kcal/g f w for the austenitic 5% and ferritic 25% alloy, respectively. Thermal etching gave rise to both faceted and specular surfaces.

1514

McMaster U. Hamilton Coll., Ont. (Canada).

THE NUCLEAR MAGNETIC RESONANCE SPECTRUM

OF SULPHUR TETRAFLUORIDE, by J. Bacon, R. J. Gillespie, and J. W. Quail. [1962] [3]p. incl. diagr. table, refs. (AFOSR-J484) (AF AFOSR-62-21) Unclassified

Also published in Canad. Jour. Chem., v. 41: 1016-1018, Apr. 1963.

The F^{19} nuclear magnetic resonance spectrum of SF_4 was resolved into 2 center-symmetrical triplets of lines at -60°C. At -90°C all triplet peaks were observed to split into doublets. Analysis was accomplished by treating SF_4 as an A_2B_2 system in which the 2 coupling constants between nonequivalent nuclei are equal.

1515

McMaster U. [Hamilton Coll.] Dept. of Physics, Ont. (Canada).

SOME PRECISION MASS DIFFERENCES BETWEEN TIN ISOTOPES, by R. C. Barber, L. A. Cambey and others. [1962] [1]p. incl. tables. (AFOSR-3529) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-33, and National Research Council of Canada) Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 16, July 1, 1962.

The large double-focusing mass spectrometer is now operating with a resolving power at the base of the peaks of 10^{-5}. Values are given for $Sn^{A+2}Cl^{35}$-$Sn^{A}Cl^{37}$ an accuracy of ± 2 μ amu. From these and the difference of Cl^{37}-Cl^{35}, which is known within ± 3.6 μ amu, the mass difference between several tin isotopes is derived.

1516

McMaster U. [Hamilton Coll.] Dept. of Physics, Ont. (Canada).

SOME ATOMIC MASSES AND NEUTRON SEPARATION ENERGIES FOR ISOTOPES OF TIN AND ANTIMONY, by R. C. Barber, R. L. Bishop and others. [1962] [2]p. incl. tables, refs. (AFOSR-3961) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-33 and National Research Council of Canada) Unclassified

Also published in Canad. Jour. Phys., v. 40: 1496-1497, Oct. 1962.

The absolute masses of Sn^{116}, Sn^{117}, Sn^{118}, Sn^{119}, Sn^{120}, Sn^{122}, Sn^{124}, Sb^{121}, and Sb^{123} were measured with a high resolution mass spectrometer. The neutron separation energies of these isotopes plus those of Sn^{121} and Sn^{123}, are given in tabular form and compared with previous results.

1517

McMaster U. [Hamilton Coll.] Dept. of Physics, Ont. (Canada).

ENERGY LOSS IN CONDENSED MATTER OF H^1 AND He^4 IN THE ENERGY RANGE 4 < E < 30 KEV, by A. Van Wijngaarden and H. E. Duckworth. [1962] [16]p. incl. diagrs. tables, refs. (AFOSR-J45) (AF AFOSR-62-33) AD 297160 Unclassified

Also published in Canad. Jour. Phys., v. 40: 1749-1764, Dec. 1962.

Measurements are reported of the energy loss suffered by H^1 and He^4 particles, of 4- to 30-kev energy, in passing through thin films of carbon, aluminum oxide, and VYNS. Only those particles that emerged in the forward direction were studied. Evidence is presented for identifying the stopping cross sections per atom observed in this way with S_e, the electronic component of the total stopping cross section per atom. It appears that the calculated energy dependence of $S_e(\propto \sqrt{E})$ is somewhat in error, and that the magnitudes of the S_e's for He^4 are systematically too small by 10-15%. (Contractor's abstract)

1518

McMaster U. [Hamilton Coll.] Dept. of Physics, Ont. (Canada).

THE VACUUM VIBRATOR AS A SOURCE OF IONS FOR MASS SPECTROSCOPY, by V. S. Venkatasubramanian and H. E. Duckworth. [1962] [6]p. incl. diagrs. refs. (AFOSR-J659) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-33 and National Research Council of Canada) AD 413464 Unclassified

Also published in Canad. Jour. Phys., v. 41: 234-239, Feb. 1963.

The metallic ions that are produced in the arc that occurs when a contact is broken in a vacuum have been studied. The energy spread among such ions is significantly smaller than for the ions produced in a vacuum spark. Also, the relative ionization efficiencies for both singly and doubly charged ions can be greatly different in the 2 cases. (Contractor's abstract, modified)

1519

McMaster U. [Hamilton Coll.] Dept. of Physics, Ont. (Canada).

RELATIVE IONIZATION EFFICIENCIES FOR ELEMENTS IN A SPARK SOURCE, by B. Chakravarty, V. S. Venkatasubramanian, and H. E. Duckworth. [1961] [7]p. incl. illus. diagrs. tables. (AFOSR-J745) (AF AFOSR-62-33) AD 413638 Unclassified

Also published in Advances in Mass Spectrometry; Proc. of a Conf., Oxford (Gt. Brit.) (Sept. 1961), New York, Pergamon Press, v. 2: 128-134, 1963.

Samples of commercially available alloys of known composition and an alloy of the intermetallic compound $CuAl_2$ have been examined. From the measured peak heights and the known composition of the samples, the relative ionization efficiencies are computed. While these are found to be the same for all isotopes, the variation for different elements studied amounts to about a factor of 3. Results are presented in table form.

1520

Madrid U. [Dept. of Crystallography] (Spain).

[THERMAL EXPANSION OF OXALIC ACID DIHYDRATE IN THE TEMPERATURE RANGE -185°C AND +50°C AND THE PROCESS OF DEHYDRATION] Dilatación térmica del ácido oxálico dihidratado entre -185°C y +50°C y proceso de deshidratación, by E. Neira and M. L. Canut. [1962] [17]p. incl. illus. diagrs. tables, refs. (AFOSR-J272) (AF EOAR-62-92) AD 401098 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 60: 195-210, 1962.

The thermal expansion of the oxalic acid dihydrate has been studied by Weissenberg technique in the temperature range -185°C and +50°C. Above 50°C the dehydration begins to take place and the crystal transforms into the α-oxalic acid anhydrous. At 60°C coexistence of the dihydrate and anhydrous phases can be seen in the x-ray rotation photographs, the dihydrate phase appearing in a single crystal form, but the anhydrous polycrystalline with some preferred orientation. As the temperature rises the texture disappears and the whole crystal becomes α-form, polycrystalline. After waiting 15 min the rotation diagram shows again, coexistence of both phases. After 24 hr the whole polycrystal belongs to dihydrate form. These x-ray results are supported by thermograms, from which at 85°C the 2 water molecules have gone out. The 3 mean sections of the thermal expansion surfaces as deduced by least squares from the experimental data have been analyzed with the corresponding projection of the structure. The maximum of the expansion is along (010) and the minimum normal to the projection of the hydrogen bonds in (010) linking the oxalic acid through the water molecules. The values of the mean expansion coefficients are: $\alpha_{11} = -1.5$, $\alpha_{22} = 147.3$, and $\alpha_{33} = 57.09 \times 10^{-6}$ (between -185°C and 20°C) and $\alpha_{11} = -1.3$.

1521

Madrid U. [Dept. of Crystallography] (Spain).

[SURFACE OF CRYSTALS. III. SURFACE GROWTH AND FRACTURE IN PYRITE] Superficies de cristales. III. Superficies de crecimiento y fractura en la pirita, by J. L. Amorós and M. T. Pascual. [1962] [15]p. incl. illus. diagrs. table, refs. (AFOSR-J273) (AF AFOSR-62-92) AD 401102 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 60: 213-227, 1962.

Pyrite shows some peculiarities in its growth surfaces. Growth steps and its shape are explained via P. B. C. (Hartman's) theory. Both (100) and (210) F faces are responsible for the appearance of long growth steps that give the striated appearance to pyrite cyrstals. Fracture and parting determining characteristic features in broken crystals are also studied and described. (Contractor's abstract)

1522

[Madrid U. Inst. de Calculo (Spain)]

SEMIANALYTICAL CLASSES WITH W-CONVEX BOUNDS, by R. San-Juan Llosá. Final rept., pt. 1. [1962] [60]p. incl. refs. (AFOSR-2397, pt. 1) (AF 61-(052)316) AD 289177 Unclassified

This research concerns the theory of semi-analytic functions, their properties and their behavior. The investigation includes studies of semi-analytical classes in convex regions, circular convex domains, and distances in convex regions.

1523

Madrid U. [Inst. de Calculo] (Spain).

EQUIVALENCE OF DAVIS THEORY WITH THAT OF CARLEMAN FOR CERTAIN DOMAINS, by R. San-Juan Llosá. Final rept., pt. 2. [1962] [27]p. incl. refs. (AFOSR-2397, pt. 2) (AF 61(052)316) AD 289178 Unclassified

Also published in Jour. Math. Pures et Appl., v. 42: 167-193, 1963.

Let G be a domain whose boundary C is a rectifiable Jordan curve which has finite total length, passes through 0 and contains 1 as an interior point. Let a sequence of positive numbers $\{m_n\}$ be given, and designate by $C_0(m_n, G)$ and $D_0(m_n, G)$ the sets of functions f(z) that are regular in G and satisfy relatively $\sup_{z \in G} |f(z)z^{-n}| < ck^n m_n$ or $\int_C |f(z)z^{-n}|^2 |dz| < C_1 k_1^{2n} m_n^2$ (n = 0, 1, ...). The constants c, c_1, k, k_1 are independent of n and the integral is interpreted as $\lim_{r \to 1^-} \cdot C_r$, where C_r are level curves interior to G.

The sequence $\{m_n\}$ is said to verify the condition C(G) or D(G) if the sets $C_0(m_n, G)$ or $D_0(m_n, G)$ are, respectively, empty. These conditions are relevant to the study of uniqueness classes for asymptotic expansion of analytic functions in general domains. Employing bounds which he had previously established, together

with well-known properties of conformal maps, the author establishes the equivalence of conditions C(G) and D(G) for some extensive classes of domains G. (Math. Rev. abstract, modified)

1524

[Madrid U. Inst. de Calculo (Spain).]

THE UNIQUENESS PROBLEM IN THE THEORY OF NUMERICAL DIVERGENT SERIES AND FORMAL LAWS OF CALCULUS, by R. San-Juan Llosá. Final rept., pt. 3 [1962] [96]p. incl. refs. (AFOSR-2397, pt. 3) (AF 61-(052)316) AD 289179 Unclassified

Semi-analytical functions are applied to the summation of divergent series. Work is also done on the uniqueness of asymptotic expansions.

1525

Maine U. Dept. of Physics, Orono.

DIELECTRIC LOSS IN THE LIQUID CRYSTAL p-AZOXYANISOLE, by E. F. Carr. [1962] [3]p. incl. diagrs. (AFOSR-2113) (AF AFOSR-61-45) Unclassified

Also published in Jour. Chem. Phys., v. 37: 104-106, July 1, 1962.

The real and imaginary parts of the complex dielectric constant of the normal liquid phase of p-azoxyanisole were measured at a temperature of 140°C for a frequency range from 900 mc to 24 kmc. A plot of the complex dielectric constant in the complex plane satisfies the requirements for a Cole-Cole representation reasonably well. The temperature dependence of the dielectric loss at a frequency of 6 kmc shows an absorption maximum in the neighborhood of the clearing point (135°C) for both the anisotropic and normal liquid phases. Measurements of the dielectric loss at frequencies 500 and 900 mc indicate an increase in the dielectric loss as the sample changes from the anisotropic to the normal liquid phase. This change could not be established for measurements at other frequencies reported in this paper. (Contractor's abstract)

1526

Maine U. Dept. of Physics, Orono.

INFLUENCE OF ELECTRIC AND MAGNETIC FIELDS ON THE DIELECTRIC CONSTANT AND LOSS OF THE LIQUID CRYSTAL ANISALDAZINE, by E. F. Carr. [1962] [5]p. incl. diagrs. refs. (AFOSR-J 688) (AF AFOSR-61-45) AD 413629 Unclassified

Also published in Jour. Chem. Phys., v. 38: 1536-1540, Apr. 1, 1963.

The real and imaginary parts of the complex dielectric constant of the normal liquid phase of anisaldazine were measured at a temperature of 185°C for a frequency range from 900 mc to 24 kmc. A plot of the complex dielectric constant in the complex plane satisfies the requirements for the Cole-Cole representation reasonably well. The temperature dependence of the dielectric loss at frequencies 6, 15, and 24 kmc indicates that any changes in the dielectric loss for a random orientation are very small as anisaldazine passes from its anisotropic to normal liquid phase. This implies that a plot of the complex dielectric constant in the complex plane for the anisotropic phase would probably satisfy the requirements for a Cole-Cole plot. Measurements of the dielectric loss in the presence of an external electrostatic field show that an ordering exists with the long axes of the molecules parallel to the external electric field. (Contractor's abstract)

Mallinckrodt Chemical Lab., Cambridge, Mass.
see Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.

1527

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

THE EXPONENT OF A PRIMITIVE MATRIX, by A. L. Dulmage and N. S. Mendelsohn. [1962] [4]p. (AFOSR-J50) (AF AFOSR-62-235) Unclassified

Also published in Canad. Math. Bull., v. 5: 241-244, Sept. 1962.

Let A be a non-negative irreducible (primitive) n by n matrix. If matrix A contains r non-zero entries along its main diagonal then its exponent is at most $2n - r - 1$. If all the diagonal entries of A are zero but its graph K_A contains a cycle of length d, then the exponent of A is at most $D(2n - d - 1)$. For the case where $d \neq n/2$ this improves Wielandt's result.

1528

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

REMARKS ON SOLUTIONS OF THE OPTIMAL ASSIGNMENT PROBLEM, by A. L. Dulmage and N. S. Mendelsohn. [1962] [7]p. (AFOSR-64-0671) (AF AFOSR-62-235) AD 436365 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 11: 1103-1109, Dec. 1963.

The canonical decomposition of a bipartite graph is used to reduce the problem of finding all dual solutions of an optimal assignment problem to the problem of finding all dual solutions when there is only one primal solution. The dimension of the space of dual solutions is shown to be equal to the number of irreducible subgraphs in the core of a certain bipartite graph.

1529

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

THE CHARACTERISTIC EQUATION OF AN IMPRIMITIVE MATRIX, by A. L. Dulmage and N. S. Mendelsohn. [1962] [12]p. incl. refs. (AFOSR-64-0672) (AF AFOSR-62-235) AD 436364 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 11: 1034-1045, Dec. 1963.

If A is a nonnegative cyclic matrix of index d, then there exists a permutation matrix P such that $P^{-1}A^dP = \text{diag}(A_1, A_2, \ldots, A_d)$. It is known that each A_i is primitive with the same root of maximum modulus.

In this paper, it is shown, if A is weakly cyclic of index k, that the matrices $A_1, A_2, \ldots, A_k$ have the same nonzero characteristic roots with identical multiplicities. Further, if α is a characteristic root of A_1 and if $\alpha_1, \alpha_2, \ldots, \alpha_k$ are the distinct kth roots of α and if $W^{(1)}$ is a characteristic vector of A_1 which corresponds to α, then, for i = 1, 2, ..., k, a construction is given expressing the characteristic vector of A which corresponds to α_j in terms of $W^{(1)}$ and the cyclic components of A. This construction is reversible and implies that the vector spaces of $A_1, A_2, \ldots, A_k$ corresponding to a nonzero characteristic root α have the same dimensionality. The theory of direct graphs is used to investigate the connection between the irreducibility of $A_1, A_2, \ldots, A_k$ and the irreducibility of A. There is an application to Markov chains. The fixed vector of the transition matrix A of an irregular ergodic Markov chain is expressed in terms of the fixed vector of A_1 and the cyclic components of A.

1530

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

A REMARK ON A RESULT OF MARVIN MARCUS, by A. L. Dulmage and N. S. Mendelsohn. [1962] [3]p. (AF AFOSR-62-235) Unclassified

Published in Canad. Math. Bull., v. 6: 11-13, Jan. 1963.

Suppose A is a non-negative normal matrix satisfying $p(A) = 0$ in which $p(\lambda)$ is a monic polynomial no 2 of whose nonzero roots have the same modulus. Then there exists a permutation matrix P such that PAP^* is a direct sum, $PAP^* = A_1 \oplus A_2 \oplus \ldots \oplus A_m$, in which each A_i is either O or primitive. This note gives a generalization of this result, dropping the non-negative assumption and weakening the normality assumption. (Contractor's abstract)

1531

[Marey Inst.] Paris (France).

[PRIMARY NEUROPHYSIOLOGICAL APPLICATIONS OF A METHOD ALLOWING EFFECTIVE AND REVERSIBLE BLOCKADE OF CENTRAL STRUCTURES BY LOCALIZED COOLING] Premières applications neurophysiologiques d'une méthode permettant le blocage electif et réversible de structures centrales par réfrigération localisée, by M. Dondey, D. Albe-Fessard, and J. Le Beau. [1962] [6]p. incl. illus. diagrs. (AFOSR-J639) (AF 61(052)103) AD 414038; AD 832142 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol., v. 14: 758-763, 1962.

A technique for local cooling of deep structures has been applied to block the somesthetic thalamic relay in cats; it utilizes the expansion of a compressed gas at the tip of a probe. Isotherms have been determined in vitro. The time course of temperatures could be traced in vivo for points at various distances from the probe by means of stereotaxic placement of thermocouples and for different durations of fluid expansion, using either butane or propane. Alterations of the transmission through the VPL nucleus have been monitored by recording the cortical evoked potentials at the level of SI; activity of the VPL was also recorded. The cortical potential vanished when the temperature in VPL fell below 20°C, and reappeared when it rose above 28°C; the response did not disappear until about 8°C, after having displayed a phase of augmentation. The block of transmission thus produced was reversible. Histological controls revealed no tissue damage provided the temperature had not fallen lower than 0°C, whereas a more intense cooling resulted in extensive lesion in the tissue around the probe. A delayed depression that occurs several minutes after the cooling phase has been observed at times; it is analogous to the spreading depression of Leao.

1532

[Marey Inst.] Paris (France).

[MODIFICATION OF SENSORY CORTICAL RESPONSES BY STIMULATION OF THE DORSAL HIPPOCAMPUS OF THE RABBIT] Modification des réponses sensorielles corticales par stimulation del'hippocampe dorsal chez le Lapin, by P. Cazard and P. Buser. [1962] [13]p. incl. illus. diagrs. refs. (AFOSR-64-0171) (AF 61(052)103) AD 432736 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol., v. 15: 413-425, June 1963.

This study has been performed on 20 rabbits, either under deep chloralose anesthesia, or immobilized with curare and having only local anesthesia, as well as on 7 free implanted animals. In either type of preparation a short, repetitive, non-epileptogenic stimulation of the dorsal hippocampus elicits an increase in amplitude of sensory cortical responses to peripheral stimuli, especially of those recorded from the motor cortex. This effect develops progressively from the end of the

hippocampal stimulation; it may last for up to several minutes. However, it is a labile phenomenon which sometimes fails to appear; hippocampal tetanization is then only followed by a depression. In unanesthetized preparations (curarized or free), hippocampal stimulation also elicits large amplitude, slow electrocortical rhythms. However, no close correlation has been noticed between these electrocortical changes and the amplification of the evoked potentials. In free implanted animals, hippocampal stimulation produces moreover an attentive or searching behavior. In free animals, also, repeated associations of peripheral and hippocampal stimulations have led to long term facilitatory effects on sensory evoked potentials.

1533

[Marey Inst.] Paris (France).

[SENSORY RESPONSES RECORDED FROM THE MOTOR CORTEX OF THE RABBIT] Réponses sensorielles recueillies au niveau du cortex moteur chez le Lapin, by P. Cazard and P. Buser. [1962] [10]p. incl. illus. diagrs. refs. (AFOSR-64-0172) (AF 61-(052)103) AD 432737 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol., v. 15: 403-412, June 1963.

The characteristics of non-primary sensory responses recorded from the rabbit's neocortex have been investigated. Three types of preparations were used: deep chloralose anesthesia, local anesthesia associated with curarization, and free implanted animals. Responses may be elicited on the motor cortex by somesthetic, auditory and visual stimulations. These nonprimary responses are easily observed in normal implanted animals; in acute preparations, somesthetic responses are well developed, whereas auditory and visual ones are usually small. Evoked potentials from the motor area are distinguished from primary sensory responses by various characteristics, such as a longer latency, a higher sensitivity to repetition of the stimuli, or to depressive actions. In unanesthetized preparations (curarized or free), their amplitude depends upon the general electrocortical activity, in that arousal reactions abolish them. These responses closely resemble phenomena recorded from the cat's motor area. In the rabbit, also, the motor cortex thus appears as a polysensory area.

1534

[Marey Inst.] Paris (France).

CHOLINERGIC TRANSMISSION MECHANISMS FOR BOTH EXCITATION AND INHIBITION IN MOLLUSCAN CENTRAL SYNAPSES, by L. Tauc and H. M. Gerschenfeld. [1961] [2]p. incl. illus. diagrs. refs. [AF 61(052)103] AD 632612 Unclassified

Also published in Nature, v. 192: 366-367, Oct. 28, 1961.

Conclusions are summarized as follows: (1) In earlier papers by the authors, acetylcholine, by its effects on Aplysia depilans neurones, enables one to distinguish 2 types of cells: D-cells, depolarized and excited by the drug, and H-cells, hyperpolarized and inhibited. The D-neurones only show excitatory synaptic input, whereas H-neurones present both excitatory and inhibitory synaptic input. (2) In D-neurones, the synaptic excitatory input may be considered as cholinergic. (3) In H-neurones, inhibitory input is also very likely cholinergic, but the excitatory input in these cells appears to depend on another, unknown chemical transmitter. Hence, the character of synaptic transmission, excitatory in D-cells and inhibitory in H-cells, does not depend solely on the nature of the chemical transmitter-acetylcholine in both cases—but on physicochemical differences in the postsynaptic membrane that react in a specific way to the transmitter. (4) Existence of interneurones which would simultaneously induce excitatory and inhibitory synaptic actions in different postsynaptic neurones is a real possibility.

1535

[Marey Inst.] Paris (France).

[DUALITY OF SENSORY AFFERENT STIMULATION CONTROLLING THE ACTIVITY OF THE RED NUCLEUS] Dualité des voies sensorielles afférentes controlant l'activité du noyau rouge, by J. Massion and D. Albe-Fessard. [1962] [20]p. incl. illus. diagr. table, refs. [AF 61(052)103] Unclassified

Published in Electroencephalog. and Clin. Neurophysiol., v. 15: 435-454, June 1963.

In the cat under chloralose, evoked responses to somatic, visual and auditory stimulation were studied in the red nucleus with microelectrodes and concentric macro-electrodes. In the parvocellular portion, unit responses most often have a short latency and are followed by a phase of inhibition; the units of this region are the site of heterosensory convergence. In the magnocellular portion, sensory stimulation, like stimulation of the sensorimotor cortex, induces a short latency response followed by a phase of inhibition and finally by renewed long latency and prolonged activation. Sensory convergence is less marked in the units of the magnocellular portion. Some of them are the site of clearly somatotopic projections. Experiments with total and then localized ablation of the cerebellum have shown that the afferent influx reaches the magnocellular portion by 2 different neural paths. Stimulation of the intermediate part of the contralateral anterior lobe induces selectively the late elements of the response of the red nucleus to sensory stimulation. Stimulation of the nucleus interpositus induces an excitatory monosynaptic response in the contralateral magnocellular portion. After cerebellectomy, the spontaneous activity of the neurones of the magnocellular portion is strongly depressed. The natural somatic stimulation capable of influencing the activity of the neurons of the magnocellular portion consists in a brief mechanical shock applied to the skin or the aponeuroses. The excitation of Group I fibers of muscular origin has no discernible effect on the cells of the magnocellular portion. In the cat maintained awake under local anesthesia, somatic stimulation can evoke the same unit reactions as in the chloralose anesthetized cat; but this same stimulus can also induce a prolonged unit activation not preceded by a phase of inhibition. The characteristics of the reflex and tonic actions of the cerebellum on the red nucleus are analyzed in the discussion.

1536

[Marey Inst.] Paris (France).

[INFLUENCE OF THE SENSORY CORTICAL AREAS ON THE EXTRAPYRAMIDAL MOTOR RESPONSES] Participation des aires corticales sensorielles a l'elaboration de responses motrices entrapyramidales, by P. Ascher, D. Jassik-Gerschenfeld, and P. Buser. [1962] [19]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)103] and Delegation Générale à la Recherche Scientifique et Technique) Unclassified

Published in Electroencephalog. and Clin. Neurophysiol., v. 15: 246-264, Apr. 1963.

Ablation of the primary fields corresponding with a given sensory modality does not abolish the root discharges to stimulation of the modality. Following local strychnine application to one sensory area, the increase in amplitude of both phases of the primary evoked potential is usually accompanied by an increase of the corresponding root discharge. This effect is specific, discharges to stimulations of other sensory modalities remaining unaffected. In other experiments functional depressions of one area were obtained either by local application of KCl or by local cooling. In all cases the reduction or disappearance of the evoked potential, thus produced, was accompanied by a reduction or disappearance of root discharges to stimulation of the corresponding modality. In these instances as well the effects were modality-specific, discharges to other stimuli remaining unchanged. The detailed characteristics of these cortical actions vary with the sensory modality dealt with: whereas the whole visual cortex seems to influence elaboration of responses to light, only resitricted areas of the acoustic field seem to act upon discharges to sound. With somaesthetic responses, the specificity is such that the somatotopic organization of area I also exists for efferent effects. Results seem to indicate that for each sensory modality considered, the primary cortical exerts a non-compulsory and specific influence upon subcortical centers for sensory-motor reverberation.

1537

[Marey Inst., Paris (France)]

INFLUENCES OF THE VISUAL CORTEX UPON POSTEROMEDIAL THALAMUS IN THE CAT, by P. Buser, J. Bruner, and R. Sindberg. [1962] [15]p. incl. illus. refs. [AF 61(052)103] Unclassified

Published in Jour. Neurophysiol., v. 26: 677-691, Sept. 1963.

Two groups of related experiments were carried out to study the control by the visual cortex over visual responses in a posteromedial thalamic region comprised of the centrum medianum and adjacent structures. In the first series of experiments the primary visual cortex was stimulated electrically, while this area of the thalamus was mapped with concentric recording electrodes. A short-latency response field was found in this region, approximately coinciding with the area reported by several other investigators to respond to light, sound, and somesthetic stimulation. These data were taken to indicate the presence of rather short latency pathways through which cortical control could be exerted. Another group of experiments was devoted to studying the effects of modifying cortical excitability by drugs and by local cooling. Strychninization of the visual cortex, while producing an augmentation of responses in the cortex also increased the response in the posteromedial thalamus. On the other hand, application of KCl or of a local cooling agent to the cortex decreased or eliminated such responses. From the data obtained, it is suggested that cortical influence takes place by determining the amount of descending corticifugal outflow which is triggered by the incoming specific corticipetal volley.

1538

Marseille U. (France).

CHRONOGRAPHIC AND TOPOGRAPHIC STUDY OF CEREBRAL POTENTIALS EVOKED BY PHOTIC STIMULATION IN MAN AND IN CAT, by H. Gastaut. Apr. 30, 1962 [101]p. incl. illus. diagrs. tables, refs. (AFOSR-3219) (AF 61(052)20) AD 282541 Unclassified

Research was done in man and in the cat on the problem of evoked potentials to light. Consideration was made of the variation in form, amplitude, latency, and areas of distribution. This was done in relation to the following 3 types of factors: (a) variations of the physical characteristics of the stimulus; (b) variation of the psyche-affective state of the subject; and (c) repetition of visual stimuli to achieve habituation or conditioning. Results in man describe the character of evoked potentials for different frequencies of intermittent light stimulus. In animals results show the modifications of potentials evoked by light when the reticular formation is stimulated and during habituation and conditioning.

1539

Marseille U. (France).

SOME NEUROPHYSIOLOGICAL MECHANISM OF MOTOR CONTROL STUDIED IN MAN BY MONOSYNAPTIC TESTING, by J. Paillard. Final technical rept. May 1, 1959-Apr. 30, 1962 [22]p. incl. illus. diagrs. refs. (AFOSR-4185) (AF 61(052)95) AD 292919 Unclassified

Progress is reported on methodological problems of monosynaptic testing in man, proprioceptive regulation of spinal cord mechanisms in man, and the approach of the neurophysiological problem of background noise in effector functions.

1540

Martin-Marietta Corp. Martin Co., Baltimore, Md.

STRESS-STRAIN BEHAVIOR OF ALUMINUM CRYSTALS AT LOW PRESSURES, by I. R. Kramer and S. Podlaseck. [1962] [2]p. incl. diagr. table. (AFOSR-J1236) (AF 49-(638)946) AD 424290 Unclassified

Also published in Acta Metall., v. 11: 70-71, Jan. 1963.

Aluminum crystals were deformed at strain rates of 0.4×10^{-5} sec^{-1} at 24°C and at pressures of 760 to 10^{-8} mm Hg to give stress strain relationships. At atmospheric pressure, stage I of the relationship was absent but this appeared at 10^{-5} mm Hg, stage II was present under both conditions. Neither the critical resolved shear stress nor the stress at the end of stage I altered with pressure. Surface barriers exert a large influence on the work-hardening mechanism of metals; at lower pressures surface egress of dislocations is facilitated as the rate of oxide growth on freshly exposed surfaces is reduced.

1541

Martin Marietta Corp. [Martin Co.] Baltimore, Md.

EFFECT OF VACUUM ENVIRONMENT ON THE MECHANICAL BEHAVIOR OF MATERIALS, by I. R. Kramer and S. E. Podlaseck. Summary rept. Oct. 1, 1961-Oct. 1, 1962 [24]p. incl. diagrs. table. (Rept. no. RM-125) (AF 49(638)946) AD 450484 Unclassified

Results of a study of the fatigue, tensile, and creep behavior of metals at low pressures are presented. In fatigue, an effect of frequency of cycling on the fatigue life of aluminum is described. For the tensile studies, aluminum single crystals are shown to exhibit lower strengths as environmental pressure is lowered. High purity polycrystalline aluminum is also shown to exhibit a decrease in the flow curve in a low-pressure environment. The tensile deformation curve of polycrystalline copper, however, did not change significantly with pressure from 760 to 10^{-8} torr. For commercial purity aluminum (1100), cleaning of the surface by ion bombardment resulted in a large decrease in the plastic flow curve and an increase in the ductility. (Contractor's abstract)

1542

Maryland U. [Dept. of Mathematics] College Park.

SOME ASPECTS OF UNIQUENESS FOR SOLUTIONS TO BOUNDARY PROBLEMS, by M. H. Martin. [1962] [21]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)570 and Guggenheim Memorial Foundation) Unclassified

Published in Proc. Edinburgh Math. Soc., v. 13: 25-35, 1962.

The following problem is considered: What can be said about the uniqueness of a function u, harmonic in a region S, if along the boundary C of S the external normal derivative u_n is a prescribed separable function $u_n = h(s) f(u)$ of u and the arc length s of C? It is assumed that S is a simply connected region bounded by a single analytic curve C, and that S lies in the interior of a region R within which u is regular analytic. The functions h (s), f (u) are real functions and are assumed regular analytic for all real values of their arguments.

1543

Maryland U. [Dept. of Mathematics] College Park.

ON A MIXED BOUNDARY PROBLEM FOR AN ELLIPTIC SYSTEM OF EQUATIONS, by J. S. Kim. 1961, 72p. incl. refs. (AFOSR-3986) (AF 49(638)590) AD 622602 Unclassified

G is a bounded domain of class C^∞ in E_n. τ is an n-2 dimensional manifold of class C^∞ on the boundary ∂G which divides ∂G into 2 components $\partial^{(1)}G$ and $\partial^{(2)}G$. In G (the closure of G), the systems of partial differential operators (A) and of boundary operators (B) are considered. An L_2 - estimate is given for the operator (A) together with the boundary operators (B) under the following asumptions: (1) A(x, D) is properly elliptic; (2) Each $B^{(i)}(x, D)$ complements A(x, D) on $\partial^{(i)}G$, i = 1, 2; and (3) $B^{(1)}(x, D)$, $B^{(2)}(x, D)$ are compatible with respect to A(x, D) on τ. Using this estimate and employing Hilbert space methods, the existence of a solution of the mixed problem (C) under some additional assumptions is proved. This result generalizes that of M. Schecter.

1544

Maryland U. Dept. of Physics, College Park.

A FIELD THEORETICAL CALCULATION OF THE ONE-PION-EXCHANGE AND TWO-PION-EXCHANGE CONTRIBUTIONS TO THE PHASE SHIFTS WITH HIGHER ANGULAR MOMENTA FOR NUCLEON-NUCLEON SCATTERING, by I. Sato. Jan. 1962, 44p. incl. diagrs. tables, refs. (Technical rept. no. 238) (AFOSR-2117) (AF 49(638)24) AD 274818 Unclassified

Also published in Phys. Rev., v. 127: 1352-1364, Aug. 15, 1962.

The one-pion-exchange and two-pion-exchange parts of the S-matrix for nucleon-nucleon scattering are calculated field-theoretically. The rescattering of virtual pions by nucleons and the pion-pion interaction between virtual pions are taken into account. The S-matrix is then decomposed into the partial-wave amplitudes, and the phase shifts are calculated. Numerical evaluations are carried out for the 310-mev proton-proton scattering, and the results are compared with the phase shifts obtained by analyzing the experimental data. Without contribution of the pion-pion interaction, the results are far from agreement with experiment because of too strong attraction arising from the contributions of the two-pion-exchange part, but the contribution of the pion-pion resonance in the I = J = 1 state improves the results considerably by largely cancelling the attraction. Definite discrepancies remain between the theory and the experiments, and some unknown effects must play important roles in determining the nuclear force in the region of the internucleon distance around the Compton wave length of the pion. (Contractor's abstract)

1545

Maryland U. Dept. of Physics, College Park.

INTRODUCTORY LECTURES ON SCATTERING THEORY, by O. W. Greenberg. Jan. 1962. 75p. incl. diagrs.; (Technical rept. no. 245) (AFOSR-2409) (AF 49(638)-24) AD 275054 Unclassified

This report consists of notes on 12 lectures on non-relativistic scattering theory given to a class of second year graduate students at Maryland U. in the fall semester of the 1961-1962 academic year. The notes are organized into 2 sections. Section I, Wave packet treatment of scattering, discusses the following topics: requirements on initial (unscattered) wave packet, motion of free wave packet, scattering solutions of Schrödinger equation, scattering length and effective range theory, and resonant scattering. Section II, Formal theory of scattering, includes notes on: Møller wave operators and the S-matrix, scattering in the Dirac picture, adiabatic switching, the T-matrix, and cross sections, and additional topics.

1546

Maryland U. Dept. of Physics, College Park.

RELATIVISTIC INVARIANCE AND THE SQUARE-ROOT KLEIN-GORDON EQUATION, by J. Sucher. [1962] [20]p. (Technical rept. no. 246) (AFOSR-2410) (AF 49(638)24) AD 275473 Unclassified

Also published in Jour. Math. Phys., v. 4: 17-23, Jan. 1963.

Although the usual operator invariance requirements and corresponding commutation conditions encountered in the study of the invariance of relativistic wave equations (and other equations of physics) are sufficient conditions for invariance, they are by no means necessary. More general conditions are given and illustrated with the square-root Klein-Gordon equation. A new proof is thereby given of the Lorentz invariance of this equation. The methods developed are extended to cover the presence of external fields and it is proved that the usual gauge invariant modification of the relativistic Hamiltonian of a spinless particle which takes into account the presence of an external electromagnetic field leads, in the quantum mechanical case, to an equation which does not admit the proper Lorentz group. This theorem and its generalization are discussed in connection with Dirac's statement that the square-root equation cannot be extended to include interaction without losing Lorentz invariance. (Contractor's abstract)

1547

Maryland U. Dept. of Physics, College Park.

RELATIVISTIC QUANTUM MECHANICS AND QUANTUM FIELD THEORY, VOLUME II, by J. Sucher. Mar. 1962, 300p. incl. diagrs. (Technical rept. no. 249) (AFOSR-2477) (AF 49(638)24) AD 289186 Unclassified

These notes contain part of the material covered in the lectures. The rest, for which no notes were taken, concerned itself mainly with the modified propagation functions and renormalization in quantum electrodynamics matters which are well covered in recent textbooks. The major aim was to keep the discussion as simple and informal as possible. To this end the Coulomb gauge was used and the rules for working with time-ordered diagrams were developed in great detail, in conjunction with the study of Compton and Møller scattering. These results were used to suggest the form of the covariant Feynman rules, and Feynman diagrams were then discussed in their own right from the point of view of the Feynman-Dyson-Wick analysis of the S-matrix. A fair amount of attention was paid to the connection between time-ordered and Feynman diagrams on the one hand and between time-ordered diagrams and non-relativistic quantum electrodynamics on the other.

1548

Maryland U. Dept. of Physics, College Park.

HEISENBERG FIELDS WHICH VANISH ON DOMAINS OF MOMENTUM SPACE, by O. W. Greenberg. Apr. 1962 [25]p. incl. diagrs. refs. (Technical rept. no. 251) (AFOSR-2500) (AF 49(638)24) AD 275907 Unclassified

Also published in Jour. Math. Phys., v. 3: 859-866, Sept.-Oct. 1962.

If a local Heisenberg field vanishes, or, where appropriate, has an infinite zero, on one of the momentum space domains, then the field is a generalized free field. Counter examples show that this conclusion cannot be drawn if the field vanishes on the momentum space domains. It follows that if 2 fields in the same Borchers class are equal on 1 of the domains, then the fields differ at most by a generalized free field in their Borchers class. (Contractor's abstract)

1549

Maryland U. Dept. of Physics, College Park.

A MODEL OF THE PIONIC DECAYS OF Σ-HYPERONS, by S. Y. Shieh. Apr. 1962, 11p. (Technical rept. no. 252) (AFOSR-2637) (AF 49(638)24) AD 276197 Unclassified

An attempt is made to correlate questions such as those concerning (1) (Σ, Λ) relative parity, (2) the relative sign of the asymmetry parameters $\alpha_{\Sigma}^{0} - p + \pi^{0}$ and $\pi\Lambda - N + \pi$, and (3) the ratio of the strong coupling constants $G_{\Sigma\Sigma\pi}$, $G_{\Sigma\Lambda\pi}$, and $G_{NN\pi}$ in the problem of pionic decays of Σ-hyperons, by assuming that Σ-hyperons first transform themselves into Λ-hyperons by strong interactions and then decay through the $\Lambda N\pi$-weak vertex.

1550

Maryland U. Dept. of Physics, College Park.

NORMALIZATION CONDITION FOR THE BETHE-SALPETER WAVE FUNCTION AND A FORMAL SOLUTION TO THE BETHE-SALPETER EQUATION, by I. Sato. June 1962, 37p. (Technical rept. no. 262) (AFOSR-2759) (AF 49(638)24) AD 289474
Unclassified

Also published in Jour. Math. Phys., v. 4: 24-35, Jan. 1963.

By the use of an inhomogeneous Bethe-Salpeter equation, a normalization condition for the Bethe-Salpeter wavefunction is obtained. This condition requires the normalization integral to be positive. A formal solution is obtained in the ladder approximation, and convergence of the normalization integral is proved by the use of this solution. This solution is also used to prove a dispersion relation for the vertex function of the compound particle and to give an approximate solution. The positiveness of the normalization integral is proved in the nonrelativistic limit. The bound state of nucleon and antinucleon is studied in the ladder-chain approximation and it is found that the normalization condition gives a finite wavefunction in spite of divergency of the normalization integral.

1551

Maryland U. Dept. of Physics, College Park.

SCATTERING FOR THE K⁻-MESON FROM THE DEUTERON, by A. K. Bhatia. Aug. 1962, 94p. incl. diagrs. tables, refs. (Technical rept. no. 265) (AFOSR-3501) (AF 49(638)24) AD 414423
Unclassified

A simple model is constructed to study the scattering of the K⁻-meson from the deuteron. This model does not treat the nucleon as heavy and takes into account the multiple scattering, the binding energy corrections and the contribution from the off-energy shell scattering. The scattering problem is investigated by using the Watson multiple scattering expansion of the transition-operator t. Considering the multiple scattering up to double order only, the t-matrix is written as $t = tp + tn + tc + t_I$, where tp and tn correspond to the single scattering of the K⁻-meson from the proton and the neutron in the deuteron. tc corresponds to the bound state contribution and t_I corresponds to the continuum state contribution of the K⁻-meson from the deuteron. The interaction K⁻-P and the K⁻-N is taken as a point interaction and is of the form $tp = t_p^o \delta(r - f/2)$; $tn = t_n^o \delta)r + f/2)$ where r and f/2 are the relative co-ordinates of the K⁻-meson and the nucleon in the center of mass system of the K⁻-d. t_p^o and t_n^o are taken as constants and are determined by using Dalitz solutions I and II given by Ross and Humphrey. (Contractor's abstract, modified)

1552

Maryland U. [Dept. of Physics] College Park.

THE FOUNDATIONS OF SCATTERING THEORY AND APPLICATIONS TO PHYSICAL PROBLEMS, by J. S. Toll and J. Sucher. Final rept. Dec. 1962, 17p. incl. refs. (AFOSR-4514) (AF 49(638)24) AD 414400
Unclassified

Several aspects of scattering theory are discussed including the normalization condition for the Bethe-Salpeter wavefunction and a solution to the Bethe-Salpeter equation, rotational invariance and the S-matrix in non-relativistic quantum mechanics, regularity of the T-matrix in the case of Dirac potential scattering, and completeness identity in field theory. Scattering theory is applied to several physical problems including a field theoretical calculation of the 1-pion exchange and 2-pion exchange contributions to the phase shifts with higher angular momenta for nucleon-nucleon scattering, scattering of the K⁻-meson from the deuteron, and a model of the pionic decays of the hyperons.

1553

Maryland U. Dept. of Physics, College Park.

COMPLETENESS IDENTITY IN FIELD THEORY, by O. W. Greenberg, H. J. Schnitzer, and E. C. G. Sudarshan. [1962] [4]p. [AF 49(638)24]
Unclassified

Published in Nuovo Cimento, Series X, v. 25: 461-464, July 16, 1962.

A procedure for orthogonalization of states of Heisenberg fields is outlined using neutral scalar fields as an example. The completeness identity is pointed out and an inconclusive discussion of mutual consistency of different completeness assumptions is given.

1554

Maryland U. [Dept. of Physics] College Park.

MULTIPLE-VALUEDNESS ARISING FROM ANALYTIC CONTINUATION IN THE MASS (Abstract), by J. H. Brehm and J. Sucher. [1962] [1]p. (In cooperation with Naval Ordnance Lab., White Oak, Md.) [AF 49(638)24]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 299, Apr. 23, 1962.

A contribution to $D\bar{D}$ annihilation through the $N\bar{N}$ state into 2 pions is considered, starting from the case in which the deuteron mass x is small enough so that there are no anomalous thresholds. Analytic continuation in x up to the physical value $x = D^2$ is carried out on this function over paths in each halfplane: $x \pm iy$. The discontinuity function has a branch point with a left-hand cut which deforms the contour in the representation in

such a way that 2 different functions are obtained, corresponding to $D^2 \pm i\sigma$. The effect is due to the presence of the right-hand cut in the $N\bar{N}$ into 2-pion amplitude. The mass continuation of πD elastic scattering through the 2N state is also shown not to be single-valued with respect to x. Here, the effect is present even if the $4N^2$ cut of the discontinuity is left out; it is shown that the super-anomalous threshold is responsible for the double-valuedness. In this case, a criterion can be established for making the choice of branch: $D^2 \pm i\sigma$.

1555

Maryland U. [Dept. of Physics] College Park.

FLUCTUATIONS IN THE FLUX TRAPPED IN SUPERCONDUCTORS (Abstract), by J. Weber and R. A. Ferrell. [1962] [1]p. [AF 49(638)399] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 324, Apr. 23, 1962.

The current flowing in a superconductor which contains trapped flux undergoes fluctuations with the mean-squared value given by

$$\langle I^2 \rangle = \frac{2}{\pi} \int_{\omega_1}^{\omega_2} \left(\frac{R}{R^2 + \omega^2 L^2} \right) \left(\frac{\hbar\omega}{2} + \frac{\hbar\omega}{e^{kT} - 1} \right) d\omega.$$

ω_1 and ω_2 are the lower and upper cutoff frequencies of the measuring apparatus; R and L are the frequency-dependent resistance and inductance. The manner in which R vanishes in the limit of zero frequency dominates the character of the fluctuations.

1556

Maryland U. Dept. of Physics, College Park.

FORBUSH DECREASES PRODUCED BY DIFFUSIVE DECELERATION MECHANISM IN INTERPLANETARY SPACE, by H. Laster, A. M. Lenchek, and S. F. Singer. [1962] [5]p. incl. diagrs. refs. (AF 49(638)530) Unclassified

Published in Jour. Geophys. Research, v. 67: 2639-2643, July 1962.

Transient decreases in the intensity of galactic cosmic radiation are known to be associated with the arrival at the earth of large clouds of magnetized solar plasma. The large scale of the phenomenon indicates that the clouds expand significantly while crossing the solar system. An interpretation is given based on the assumption that the plasma is magnetically turbulent. Cosmic rays enter the cloud, then execute a random-walk motion in space. While within the expanding cloud they must lose energy in an inverse Fermi mechanism and by betatron action in the weakening magnetic field. The energy spectrum within the cloud is depressed below the galactic spectrum. The spectrum is calculated in the isotropic approximation using age-diffusion theory, considering only the effects of spatial diffusion and energy loss. Convection is neglected. Several prominent features of observed decreases are thereby accounted for, i.e., the time profile, the magnitude, and the approximate rigidity dependence.

1557

Maryland U. Dept. of Physics, College Park.

PITCH ANGLE DIFFUSION IN A MAGNETIC MIRROR GEOMETRY, by R. C. Wentworth. [1962] [7]p. incl. diagrs. table. [AF 49(638)530] Unclassified

Published in Phys. Fluids, v. 6: 431-437, Mar. 1963.

The diffusion in pitch angle produced by Coulomb scattering of charged particles in a magnetic mirror is derived by geometrical arguments neglecting energy loss. The resultant diffusion equation in particle pitch angle and time agrees with the more fundamental Fokker-Planck equation when energy loss is neglected. The diffusion coefficient may be defined as the inverse of a lifetime and for particles in the Van Allen radiation belt it is compared to the energy loss time neglecting pitch angle diffusion. It is shown that both energy loss and pitch angle diffusion must, in general, be considered simultaneously. However, the special problem of the early diffusion of mirror points of a monoenergetic group of electrons injected at very low pitch angle is discussed, and it is shown that significant changes in mirror altitude take place before energy loss is appreciable. (Contractor's abstract, modified)

1558

Maryland U. [Dept. of Physics] College Park.

COMMENTS ON A PAPER BY P. D. GRANNIS, 'ELECTROSTATIC EROSION MECHANISMS ON THE MOON', by E. H. Walker. [1962] [2]p. (AFOSR-3109) (AF AFOSR-61-57) Unclassified

Also published in Jour. Geophys. Research, v. 67: 2586-2587, June 1962.

The calculation of electrostatic hopping of dust grains by Grannis is based on his first equation, which gives the probability p(q) for a dust grain to assimilate a net charge q as a result of random variations in the total number of negative charges that fall on the grain in a time t. This equation is $p(q) = \exp[-(q-m)^2/2\sigma^2]/\sigma\sqrt{2\pi}$, where m is the mean value of q, and σ is the variance, which is related to the projected area of the grain A, the time t, and the flux of particles ϕ, by $\sigma^2 = At\phi$. In this paper it is shown that this equation is incorrect since it does not include the effect of the potential of the dust grain on the statistical process. The correct probability function can be derived from 2 equations which give the current

to a charged grain, to obtain the probability that the next particle to hit the dust grain will be an ion or an electron when the grain is charged.

1559

Maryland U. Dept. of Physics, College Park.

INELASTIC ELECTRON SCATTERING BY THIN FILMS, by A. J. Glick. May 1962, 5p. (Technical rept. no. 254) (AFOSR-2819) (AF AFOSR-62-46) AD 440976 Unclassified

Also published in Electron Microscopy; Fifth Internat'l. Cong., Philadelphia, Pa. (Aug. 29-Sept. 5, 1962), New York, Academic Press, v. 1: AA8, 1962. (AFOSR-3384)

This paper consists of a review of the theory of electron energy loss and its relation to other properties of the scattering medium. The discussion applies particularly to electrons with energy between 10 and 100 kev and films several hundred to a thousand angstroms thick. For these conditions the effect of repeated scattering is easily identifiable and single scattering predominates. By considering the rate at which electrons in the beam lose energy $\hbar\omega$ and momentum $\hbar k$ the scattering cross section for single scattering can be expressed in terms of the frequency and wave number dependent dielectric constant, $\epsilon(k, \omega)$, of the material. A major advantage of representing the cross section in this manner is that many other quantities of interest also depend on the dielectric constant. Hence, a means is provided for relating a variety of apparently dissimilar properties of the material to its electron scattering properties.

1560

Maryland U. Dept. of Physics, College Park.

SOME PROPERTIES OF DIELECTRIC CONSTANT AND PHONON FREQUENCY OF A SUPERCONDUCTOR, by T. Nishiyama. [1962] [23]p. incl. refs. (AFOSR-3489) (AF AFOSR-62-46) AD 438299 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 1146-1178, June 16, 1963.

The dielectric constant and the phonon frequency in a superconductor have been investigated by means of Green's functions for the electronic and the total charge density fluctuation. Making use of the linearization approximation the exact expressions for the electronic dielectric constant are obtained in both the high-frequency limit and the low-frequency limit. The proof of the sum rule formula given by Rickayzen has been confirmed in the small wave number limit. The relationship between the effective interaction between electrons and the dielectric constant has been examined by considering matrix elements of the density fluctuation between pair states. In the Appendix, for a simplified effective interaction truncated in the neighborhood of the Fermi surface, the explicit expressions of the dielectric constant and the phonon frequency are obtained. (Contractor's abstract)

1561

Maryland U. [Dept. of Physics] College Park.

ON THE EQUIVALENCE OF THE BRYSK APPROXIMATION AND THE DETERMINANTAL METHOD, by D. S. Falk. Oct. 1962, 5p. (Technical rept. no. 272) (AFOSR-3939) (AF AFOSR-62-46) Unclassified

Also published in Phys. Rev., v. 129: 2340-2341, Mar. 1, 1963. (AFOSR-64-0438; AD 433069) (Title varies)

It is shown that the Brysk approximation and the first order approximation to the determinantal method for potential scattering are equivalent. (Contractor's abstract)

1562

Maryland U. [Dept. of Physics] College Park.

DIELECTRIC CONSTANT OF A SUPERCONDUCTOR, by R. E. Prange. Oct. 1962 [35]p. incl. diagrs. table, refs. (Technical rept. no. 266) (AFOSR-4074) (AF AFOSR-62-46) AD 437389 Unclassified

Also published in Phys. Rev., v. 129: 2495-2503, Mar. 15, 1963. (AFOSR-67-0167; AD 646326)

The longitudinal dielectric constant was calculated for the extended Bardeen-Cooper-Schrieffer model of a superconductor. An explicit formula is obtained which has been evaluated numerically. The competition between collective and single particle effects is pronounced, so that the dielectric function differs remarkably from the most elementary approximations to it. However, the dielectric function of the superconductor does not differ greatly from that in the normal metal in either the high frequency or static limit, regardless of the wavelength. This prevents the modifications due to superconductivity from being readily observed. In particular, the shift in the static polarizability should cause very small shifts in the phonon speed, so small that no effect on the lattice specific heat should be observed. (Contractor's abstract)

1563

Maryland U. Dept. of Physics, College Park.

TUNNELLING FROM A MANY-PARTICLE POINT OF VIEW, by R. E. Prange. Dec. 1962, 14p. incl. diagr. (Technical rept. no. 284) (AFOSR-4778) (AF AFOSR-62-46) AD 409443 Unclassified

Also published in Phys. Rev , v. 131: 1083-1086, Aug. 1, 1963.

The Hamiltonian for a system of interacting electrons in the presence of a barrier is transformed into one which can be separated into 3 parts. Two of the parts describe the electrons on the right and left sides of the barrier, while the third is a transition term which

allows tunneling through the barrier. It is shown that it is not reasonable to make the right and left hand Hamiltonians commute, but the effect of this failure is easily accounted for in perturbation theory. In addition, corrections to the transition operator arising from inter-electronic interaction are written down and discussed briefly. (Contractor's abstract)

1564

Maryland U. Dept. of Physics, College Park.

CORRECTIONS TO THE DIELECTRIC CONSTANT OF A DEGENERATE ELECTRON GAS, by A. J. Glick. [1962] [12]p. incl. diagrs. table, refs. (AFOSR-64-0436) (AF AFOSR-62-46) AD 433086 Unclassified

Also published in Phys. Rev., v. 129: 1399-1410, Feb. 1, 1963.

The Lindhard approximation to the frequency- and wave-number dependent dielectric constant, $\epsilon(k, \omega)$, provides a good description of many properties of the degenerate electron gas. However, it is known that the short-range behavior of the gas is not adequately represented by this function and it is necessary to include certain additional terms. DuBois incorporated some exchange terms into $\epsilon(k, \omega)$ and was able to obtain the correction to the plasmon excitation frequency. Though his final results are resonable and have been corroborated using alternative approaches the "corrected" dielectric constant is found to violate certain a priori restrictions. In this paper a more accurate dielectric constant is derived. In order to obtain an acceptable function which does not violate the sum rule and positive definiteness restrictions on the imaginary part it is necessary to account for 3 types of corrections. These corrections originate in (1) the effective screening of the long-range interaction between particles; (2) the shift in single-particle energies of electrons and holes; and (3) the tendency of particles and holes to form bound states when any repulsive inter-particle interaction is present. With these corrections all spurious singularities in the dielectric constant disappear. Numerical calculations of $\epsilon(k, \omega)$ and of moments of the imaginary part of this function have been carried out for an intermediate electron density equal to the density of conduction electrons in aluminum. The resulting dielectric constant departs by as much as 50% from the Lindhard form for low frequencies, but has similar qualitative features. The moments can be used to determine the high-frequency behavior and other properties of the electron gas.

1565

Maryland U. [Dept. of Physics] College Park.

EQUIVALENCE OF THE BRYSK APPROXIMATION AND THE DETERMINANTAL METHOD, by D. S. Falk. Oct. 1962, 5p. (Technical rept. no. 272) (AFOSR-64-0438) (AF AFOSR-62-46) AD 433069 Unclassified

Also published in Phys. Rev., v. 129: 2340-2341, Mar. 1, 1963. (Title varies)

For abstract see item no. 1561, Vol. VI.

1566

Maryland U. [Dept. of Physics] College Park.

ABSENCE OF THE ISOTOPE EFFECT IN SUPERCONDUCTING TRANSITION ELEMENTS (Abstract), by D. S. Falk and R. A. Ferrell. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 324, Apr. 23, 1962.

In a normal superconductor exhibiting the full isotope effect, the attractive electron-electron interaction results from the displacement of an ion as one electron of a pair approaches it. The resulting dipole moment then acts upon the second electron of the pair. It may happen on the other hand, that the electron shell of the ion is sufficiently polarizable that the influence of the first electron will be to redistribute the electrons in the shell, rather than to displace the center of the ion. In this case, superconductivity would be due to a type of Van der Waals force and no isotope effect would result. The transition elements contain shells of d electrons, and experimental optical data suggest that the polarizability may be sufficiently high that such a process dominates the usual phonon-induced superconductivity.

1567

Maryland U. [Dept. of Physics] College Park.

ANTIFERROMAGNETISM AS A POSSIBLE SOURCE OF SUPERCONDUCTIVITY (Abstract), by D. S. Falk. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 64, Jan. 24, 1962.

The absence of the isotope effect in ruthenium implies that other mechanisms, besides the electron-phonon interaction, may result in an effective electron-electron interaction which is attractive at the Fermi surface and which therefore produces the superconducting state. It is suggested that in an antiferromagnetic system, the interaction between adjacent ionic spins, compounded with the s-d exchange interaction, produces such an effective electron-electron interaction. A simple effective field calculation bears out this contention. The spin-wave calculation, complicated by the non-negligible contributions of the corrections to the spin wave approximation, will be discussed.

1568

Maryland U. [Dept. of Physics] College Park.

BINARY KERNEL FORMULATION OF A HEISENBERG MODEL OF FERROMAGNETISM, by N. I. Greenberg. [1962] [5]p. (In cooperation with Franklin Inst., Swarthmore, Pa.) (Sponsored jointly by Air Force Office

of Scientific Research under [AF AFOSR-62-46] and Atomic Energy Commission) Unclassified

Published in Jour. Math. Phys., v. 4: 405-409, Mar. 1963.

An ideal Heisenberg model of a ferromagnet for spin ½ is studied by considering the model in terms of a spin-deviation lattice gas. Utilizing the general methods of Yang and Lee, a binary kernel function is obtained in terms of which the thermodynamic properties of the lattice gas can be completely expressed. As an example, Dyson's results are rigorously obtained.

1569

Maryland U. [Dept. of Physics] College Park.

COOLING OF CONDUCTION ELECTRONS IN METALS AT VERY LOW TEMPERATURES (Abstract), by M. Fibich and R. A. Ferrell. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 219, Mar. 26, 1962.

At very low-excitation energies, a conduction electron in a metal loses energy to the other electrons at a rate proportional to the square of its excitation energy, whereas it loses energy to the lattice at a rate proportional to a higher power. For this reason, the conduction electrons at very low temperature may be expected to be in thermal equilibrium with the lattice. As the lattice is cooled down, the electron gas may remain at a higher temperature and only come into equilibrium after a finite time. The cooling rate can be calculated from the standard electron-phonon coupling, and its magnitude can be estimated for specific materials. Cases where the cooling rate may be observable and may have practical consequences are discussed.

1570

Maryland U. Dept. of Physics, College Park.

CRITICAL MAGNETIC FIELDS OF SUPERCONDUCTING FILAMENTS (Abstract), by R. A. Ferrell and A. J. Glick. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York. Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 63, Jan. 24, 1962.

The critical magnetic fields of very thin superconducting films and filaments have been estimated by a computation of the susceptibility along the lines established by Schrieffer using the nonlocal electrodynamics in the Pippard limit. The calculation assumes diffuse electron scattering at the surface of the superconductor and is carried out in the limit of thickness $d \to 0$. The critical field in this limit is a numerical coefficient times the characteristic thickness dependence of $(\lambda L^2 \xi_0/d^3)^{\frac{1}{2}}$. The coefficient can be evaluated as a numerical integral over the Pippard kernel. Errors in the approach due to the zero thickness limit and to the dependence of the energy gap on magnetic field will be discussed.

1571

Maryland U. [Dept. of Physics] College Park.

INSTANTANEOUS INTERACTION AND THE TRANSVERSE MODES OF THE GRAVITATIONAL FIELD (Abstract), by G. Hinds and J. Weber. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 320, Apr. 23, 1962.

For weak gravitational fields and suitably chosen coordinates, the Hamiltonian for an assemblage of mass points is approximated. It is indicated that bodies move as if there were an instantaneous Coulomb interaction plus retardation effects carried entirely by the transverse modes.

1572

Maryland U. [Dept. of Physics] College Park.

LONGITUDINAL COLLECTIVE RESPONSE OF A SUPERCONDUCTOR (Abstract), by R. E. Prange. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 63, Jan. 24, 1962.

The response of a superconductor to a longitudinal disturbance depends on the frequency and wave number dependent dielectric constant. It might be expected that the absorptive part of the dielectric constant vanishes for all frequencies below the energy gap frequency, especially when the Coulomb repulsion is taken into account. It is shown that this is not the case, but that for long wavelength disturbances there exists an absorptive part at low frequency. This absorptive part does not necessarily correspond to an excited state of the superconductor, since excited states give rise to an absorptive part in the inverse dielectric constant. The response under consideration corresponds to a zero of the inverse dielectric constant. The known long wavelength properties, together with gauge invariance make necessary the existence of this response.

1573

Maryland U. Dept. of Physics, College Park.

MÖSSBAUER EFFECT IN A DISORDERED CUBIC CRYSTAL (Abstract), by A. D. Dinhofer. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 546, Nov. 23, 1962.

A cubic crystal with nearest-neighbor harmonic interactions, isotopically disordered by light Mössbauer impurities, is studied by means of a perturbation theory. The frequency-distribution function is found for frequencies above the maximum unperturbed frequency, and the absorption cross section for energies shifted from resonance by these frequencies is calculated. The intensity in this region is compared with the background. The localized mode coupling is found for several values of the mass ratio, and crystal parameters, favorable for the observation of a shifted resonance, are suggested.

1574

Maryland U. [Dept. of Physics] College Park.

PROPAGATION OF GRAVITATIONAL FIELDS IN THE INDUCTION ZONE (Abstract), by D. Zipoy. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 320, Apr. 23, 1962.

When the dynamical gravitational fields in the near-induction zone around a vibrating bar are calculated, one finds that the retardation terms do not enter in first order in (r/λ) but only in higher-order terms. That is, if the motion of the bar is proportional to $\sin\omega t$, the fields near the bar are not proportional to $\sin\omega(t-r/c) \cong \sin\omega t-(r/\lambda)\cos\omega t$ but rather to $\sin\omega t + 0[(r/\lambda)^3] \propto \cos\omega t$ $(r \ll \lambda)$. This in effect implies that the near Coulomb-type gravitational fields are propagated with infinite velocity, a result well-known to astronomers but apparently to few others. The same effects appear in the fields around certain types of electromagnetic antennas.

1575

Maryland U. [Dept. of Physics] College Park.

ROLE OF VORTICES IN HIGH-FIELD SUPERCONDUCTIVITY (Abstract), by A. J. Glick and R. A. Ferrell. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 324, Apr. 23, 1962.

In order for the magnetic field to penetrate into the interior of a superconductor, it is necessary that there be nonvanishing paramagnetic term in the current density proportional to the mean momentum of paired electrons, which cancels the London diamagnetic term. Thus, the mean momentum forms a vector field which must have a certain amount of rotationality, proportional to the magnetic-flux density passing through the superconductor. But, this situation contradicts the basic irrotational-flow requirement of a superfluid. One means of reconciling the 2 requirements is to set up the usual intermediate state of alternate superconducting and normal regions, and to concentrate all of the irrotationality in the normal regions. A second possibility is that the entire metal could remain superconducting and the irrotationality could be concentrated into vortices analogous to those observed in liquid H^2.

1576

Maryland U. [Dept. of Physics] College Park.

SINGLE-NUCLEON DECAY OF THE GIANT DIPOLE STATE (Abstract), by M. Bauer and R. A. Ferrell. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-46] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 347, Apr. 23, 1962.

Because of the high-excitation energies involved, in addition to the shell-model configurations responsible for the collective behavior of the giant-dipole resonance, the particle-hole interaction can admix configurations from the continuum in which a single nucleon contains all the excitation energy. The nucleon energy in the optical well does not correspond to the single-particle resonance in view of the interaction energy shift of the dipole state. The distortion of the single-particle wavefunction is then such that the continuum configuration represents a system in which 1 particle is not actually a member of the cluster formed by the others. Thus, the possibility of damping is introduced. On this basis, partial widths and branching ratios are calculated in the case of the 22.2-mev level in O^{16}

1577

Maryland U. [Dept. of Physics] College Park.

SURFACE RESISTANCE OF SUPERCONDUCTORS (Abstract), by L. Leplae and R. A. Ferrell. [1962] [1]p. [AF AFOSR-62-46] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 324, Apr. 23, 1962.

The effect of a finite electron mean-free path on the surface impedance of a superconductor has been studied with special attention to changes produced just above the gap frequency. The impurities have the effect of producing additional absorption at long wavelengths which otherwise would give rise only to lossless London-type response. Thus, the surface resistance, involving an integration over all wavelengths, is augmented, with the increased concentrated just above the gap. The strength of this additional surface resistance, integrated

over frequency, can be related by the Kramers-Kronig relations to the well-known increase in static penetration depth which results when the electron mean-free path is increased.

1578

Maryland U. [Dept. of Physics] College Park.

INTERACTION OF PHOTONS AND GRAVITONS, by J. Weber and G. Hinds. [1962] [8]p. (AFOSR-J873) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-143 and National Science Foundation) AD 418253 Unclassified

Also published in Phys. Rev., v. 128: 2414-2421, Dec. 1, 1962.

The Hamiltonian formulation of general relativity is employed to study the interaction of photons and gravitons in the first approximation. The redundant variables are eliminated by an appropriate choice of gauge and coordinate conditions. S-matrix elements are calculated for initial states in which one photon is present and final states in which a photon and a graviton are present. Self-energy effects appear in first order but contribute nothing. Energy and momentum can be strictly conserved only if the initial and final photons and the gravitons all propagate in the same direction. For this case the S-matrix elements vanish in consequence of the null character of the Maxwell field and the transition probability is also zero. Energy need not be exactly conserved if the process occurs at a rate which is sufficiently high. Under these conditions, corresponding to energies $\gg 10^{28}$ ev, a photon might decay into another photon and a graviton. The graviton has very low energy. This cannot explain the red shift as a "tired light" phenomenon. The creation of gravitons by Coulomb scattering of photons and by scattering in a magnetostatic field is shown to occur and the cross sections are calculated. (Contractor's abstract)

1579

Maryland U. Dept. of Physics, College Park.

EFFECTS OF THE FINITE GYRORADII OR GEOMETRICALLY TRAPPED PROTONS, by A. M. Lenchek and S. F. Singer. [1962] [3]p. incl. diagr. (AFOSR-3875) (AF AFOSR-62-284) Unclassified

Also published in Jour. Geophys. Research, v. 67: 4073-4075, Sept. 1962.

It is pointed out that an observed east-west asymmetry can result from the effect of the atmospheric scale height on high-energy geometrically trapped protons.

1580

Maryland U. Dept. of Physics, College Park.

IMPULSIVE INJECTION OF ELECTRONS INTO THE EARTH'S INNER TRAPPING REGION FROM SOLAR COSMIC RAY EVENTS, by M. Liwshitz and A. M. Lenchek. [1962] [7]p. incl. table, refs. (AF AFOSR-62-284) Unclassified

Published in Jour. Geophys. Research, v. 68: 4091-4097, July 1, 1963.

The decay of albedo neutrons generated in the polar caps by solar high-energy-particle events provides an impulsive source of geomagnetically trapped electrons. The decay density due to slow albedo neutrons (which describe ballistic orbits above the atmosphere) can be calculated from simple kinematic considerations. At constant B the injection density exhibits a peak at intermediate L. At L = 2 and B = 0.22 gauss a typical large SHEP event deposits $\sim 3 \times 10^{-8}$ electron cm^{-3}. The flux from these electrons is $\sim 10^{3}$ electrons cm^{-2} sec^{-1} in the interval 0-780 kev. On account of the low efficiency for detecting these electrons, it appears that this process alone cannot account for the time variations seen in Explorer 7. (Contractor's abstract)

1581

Maryland U. [Dept. of Physics] College Park.

ASYMPTOTIC BEHAVIOR OF THE S MATRIX FOR HIGH ANGULAR MOMENTUM, by A. M. Jaffe and Y. S. Kim. [1962] [6]p. incl. refs. [AF AFOSR-62-361] Unclassified

Published in Phys. Rev., v. 129: 2818-2823, Mar. 15, 1963.

The behavior of the partial-wave transition matrix is discussed for large values of the angular momentum. For physical values of the angular momentum, it is shown that the N-channel T matrix vanishes in the high angular momentum limit. The validity of the optical model is discussed. In the Gelfand-Levitan formalism, it is shown that the 2 Jost functions coincide as the angular momentum goes to infinity along the real axis. For the Yukawa-type potentials, it is shown that the transition matrix reduces to its Born term as the real part of the complex angular momentum variable goes to infinity. (Contractor's abstract)

1582

Maryland U. Dept. of Physics, College Park.

ROTATIONAL INVARIANCE AND THE S MATRIX IN NONRELATIVISTIC QUANTUM MECHANICS, by R. Fong and J. Sucher. [1962] [5]p. incl. diagrs. (AF AFOSR-62-361) Unclassified

Published in Phys. Rev., v. 129: 2824-2829, Mar. 15, 1963.

The connection between an observable invariance property of the scattering matrix and the interaction, V, generating the scattering, is studied for a particular case; rotational invariance in nonrelativistic potential scattering. It is shown that a determination that the scattering cross section depends only on the angle between the incident and outgoing beams by no means implies that V is

invariant under rotation. This is true even if coherent incident beams are used to probe the target. Some aspects of these results and their relevance for the construction of physical theories are briefly discussed. (Contractor's abstract)

1583

Maryland U. [Dept. of Physics and Astronomy] College Park.

DIELECTRIC CONSTANT OF A SUPERCONDUCTOR, by R. E. Prange. [1962] [9]p. incl. diagrs. table, refs. (AFOSR-67-0167) (AF AFOSR-65-735) AD 646326 Unclassified

Also published in Phys. Rev., v. 129: 2495-2503, Mar. 15, 1963.

For abstract see item no. 1562, Vol. VI.

1584

Maryland U. [Dept. of Physics and Astronomy] College Park.

LIFETIME OF THE NEUTRAL PION, by V. Glaser and R. A. Ferrell. [1961] [7]p. incl. refs. (AFOSR-67-0172) (AF AFOSR-65-735) AD 646327 Unclassified

Also published in Phys. Rev., v. 121: 886-892, Feb. 1, 1961.

For abstract see item no. 1220, Vol. IV.

1585

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

[RESEARCH IN NON-EQUILIBRIUM STATISTICAL MECHANICS] by D. A. Tidman. Final rept. July 1, 1961-Jan. 31, 1962, 4p. incl. refs. (AFOSR-2033) (AF 18(600)1315) Unclassified

A brief description of the work dealing with aspects of basic plasma dynamics and applications to the plasma problems involved in space physics is given. Some examples of the type of research carried on are: investigation of the effect of Coulomb scattering on streaming instabilities, studies on wave propagation in plasmas containing a magnetic field in which the pressure is anisotropic, and research on possible ways in which electron plasma oscillations may be excited in plasma shock waves such as may occur in solar flares.

1586

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE BAKER-HAUSDORFF FORMULA AND A PROBLEM IN CRYSTAL PHYSICS, by G. H. Weiss and A. A. Maradudin. Jan. 1962, 24p. incl. refs. (Technical note no. BN-275) (AFOSR-2248) (In cooperation with Westinghouse Research Labs., Pittsburgh, Pa.) (AF 18(600)1315) Unclassified

Also published in Jour. Math. Phys., v. 3: 771-777, July-Aug. 1962.

A derivative is given of the Baker-Hausdorff formula for $z = \ln e^x e^y$ where x and y are non-commuting operators. This result is then used to obtain an expression for z in the case that $X = P^2 + Q^2$ and $y = \alpha P + \beta Q$, where P and Q are 2 operators whose commutator $[P, Q] = c$ is a c-number. With the aid of this result a very simple derivation of the expression for the intensity of x-rays scattered by the thermal vibrations of a crystal is presented. (Contractor's abstract)

1587

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ANALYTIC FUNCTIONS OF CONTINUANT MATRICES, by P. B. Abraham and G. H. Weiss. Feb. 1962, 20p. (Technical note no. BN-282) (AFOSR-2300) (AF 18-(600)1315) Unclassified

Also published in Jour. Math. Phys., v. 3: 1044-1049, Sept.-Oct. 1962.

It is shown that the Fourier method which was developed for the calculation of analytic functions of circulant matrices can also be applied to calculate analytic functions of continuant matrices. Similar calculations are developed for generalized continuant matrices which arise in connection with problems in greater than 1 dimension. (Contractor's abstract)

1588

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

RADIO EMISSION BY ELECTRONS IN THE FINE-STRUCTURE ELECTRIC FIELDS OF SHOCK WAVES, by D. A. Tidman. [1962] [9]p. incl. diagrs. refs. [AF 18(600)1315] Unclassified

Published in Phys. Fluids, v. 5: 1104-1112, Sept. 1962.

The structure of shock waves in fully ionized hydrogen in the absence of a magnetic field has been investigated by Greenberg and Trève using the Mott-Smith distribution for the protons and a local Maxwellian for the electrons. They find that large charge-separation effects occur inside the shock due to the electron-proton mass difference, thus giving rise to strong stationary electric-field oscillations in the shock transition. This behavior is typical of other theories of plasma shock structure. The radio noise emitted by electrons in the plasma accelerated in these electric fields is now calculated. In traversing the electric oscillations inside the shock, those electrons with a few times the thermal energy radiate like an assembly of oscillators at frequencies capable of propagating ahead of the shock. Although the particular shock-wave model of Greenberg and Trève

has been adopted for the purposes of the numerical discussion, the parameters of the radiation calculation are readily adjusted for possible changes in the shock-wave model which more detailed treatments of shock structure may bring. The application of this process to Type II solar radio bursts is discussed. Assuming that such shock waves are produced by a solar flare expanding into the corona, a sufficiently high intensity of radio emission is found to provide an alternate possible interpretation for this source of solar noise. (Contractor's abstract)

1589

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A NECESSARY AND SUFFICIENT CONDITION IN THE MAXIMUM-MINIMUM THEORY OF EIGENVALUES, by A. Weinstein. Jan. 1962 [14]p. incl. refs. (Technical note no. BN-276) (AFOSR-2061) (AF 49(638)228) AD 271136 Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by Gilbarg, Solomon and others. Stanford U. Press, 1962, p. 429-434.

A necessary and sufficient condition of the Sturm type is given for the equality in the maximum-minimum theory of eigenvalues. Up to now only a sufficient condition was known. The method of intermediate problems is used. (Contractor's abstract)

1590

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

FOURTH ORDER FINITE DIFFERENCE ANALOGUES OF THE DIRICHLET PROBLEM FOR POISSON'S EQUATION IN THREE AND FOUR DIMENSIONS, by J. H. Bramble. Jan. 1962, 13p. (Technical note no. BN-273) (AFOSR-2137) (AF 49(638)228) AD 271671 Unclassified

Also published in Math. Comput., v. 17: 217-222, July 1963.

Difference analogues of the Dirichlet problem for Poisson's equation in 3 and 4 dimensions are formulated. These analogues are shown to be $O(h^4)$ as $h \to 0$. (Contractor's abstract)

1591

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON ALMOST PERIODIC SOLUTIONS OF A CLASS OF ELLIPTIC EQUATIONS, by A. Weinstein. Feb. 1962, 7p. (Technical note no. BN-279) (AFOSR-2138) (AF 49(638)228) AD 272610 Unclassified

Also published in Atti. Accad. Naz. Lincei Rend., Classe Sci. Fis. Mat. e Nat., v. 32: 863-866, June 1962. (AFOSR-J11)

It is proved that all solutions of a class of elliptic equations which are bounded in a strip and satisfy homogeneous boundary conditions are almost periodic. (Contractor's abstract)

1592

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME INEQUALITIES FOR VECTOR FUNCTIONS WITH APPLICATIONS IN ELASTICITY, by J. H. Bramble and L. E. Payne. Jan. 1962 [23]p. (Technical note no. BN-272) (AFOSR-2145) (AF 49(638)228) AD 271680 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 11: 16-26, 1962.

A number of a priori inequalities for vector functions are derived. These inequalities may be employed to give bounds in the second boundary value problem of elasticity. (Contractor's abstract)

1593

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME A PRIORI INEQUALITIES FOR UNIFORMLY ELLIPTIC OPERATORS WITH APPLICATION TO THE CAUCHY PROBLEM, by L. E. Payne. Feb. 1962, 14p. (Technical note no. BN-280) (AFOSR-2270) (AF 49-(638)228) Unclassified

Certain explicit a priori inequalities for uniformly elliptic operators are derived. These inequalities may be used in obtaining pointwise bounds in the Cauchy problems for elliptic equations. (Contractor's abstract)

1594

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A THEOREM ON ERROR ESTIMATION FOR FINITE DIFFERENCE ANALOGUES OF THE DIRICHLET PROBLEM FOR ELLIPTIC EQUATIONS, by J. H. Bramble and B. E. Hubbard. Feb. 1962, 25p. incl. refs. (Technical note no. BN-281) (AFOSR-2371) (AF 49(638)228) AD 274315 Unclassified

Also published in Contrib. Differential Equations, v. 2: 319-340, 1963.

A general theorem on error estimation is stated which can be used as a guide in the formulation of finite difference analogues of the Dirichlet problem for elliptic equations. As examples of application of this theorem, 2 finite difference analogues are presented and the

corresponding discretization errors are shown to be $O(h^2)$ and $O(h^4)$ respectively, where h is the mesh size. (Contractor's abstract)

1595

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

POISSON'S EQUATION AND GENERALIZED AXIALLY SYMMETHC POTENTIAL THEORY, by R. P. Gilbert. Mar. 1962 [21]p. incl. refs. (Technical note no. BN-283) (AFOSR-2450) (AF 49(638)228) AD 274316 Unclassified

A method is developed by which one may obtain solutions to the non-homogeneous equation of generalized axially symmetric potential theory (GASPT). Representation formulae are obtained and the method is shown to be extendable under certain symmetry conditions to the Poisson equation in 3 variables. (Contractor's abstract)

1596

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

FUNDAMENTAL SOLUTIONS FOR A CLASS OF SINGULAR EQUATIONS, by R. J. Weinacht. June 1962, 72p. incl. refs. (Technical note no. BN-228) (AFOSR-2616) (AF 49(638)228) AD 275?.9 Unclassified

Also published in Contrib. Differential Equations, v. 3: 43-55, 1964.

Singular linear elliptic partial differential equations associated with the operator of generalized axially symmetric potential theory are presented. Explicit fundamental solutions in the large are given for the equations. Mean value theorems for solutions of these equations are also presented.

1597

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

BOUNDS ON THE TRUNCATION ERROR BY FINITE DIFFERENCES FOR THE GOURSAT PROBLEM, by A. K. Aziz and B. E. Hubbard. May 1962, 29p. incl. refs. (Technical note no. BN-289) (AFOSR-2727) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)228 and Naval Ordnance Lab.) AD 289185; AD 453995 Unclassified

Also published in Math. Comput., v. 18: 19-35, Jan. 1964.

A common method for obtaining an approximate solution to the various boundary value problems for partial differential equations is by finite differences. The fundamental problem concerning such finite difference approximations is to show that the truncation error tends to zero with diminishing mesh size. In general the main tool used in obtaining estimates for the solution of hyperbolic equations is the energy method. In this paper, explicit bounds are obtained in terms of the data of the problem for the linear and non-linear second order partial differential equation of hyperbolic type in 2 independent variables. The present approach is based not on the energy method but on the method of majorants which is embodied in the statement of the following theorem and its corollaries: $Lu = u_{xy} + au_x + bu_y + cu = f$ in R where R is the first quadrant of the (x, y) plane.

1598

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

BOUNDS FOR EIGENVALUES OF THE STURM-LIOUVILLE PROBLEM BY FINITE DIFFERENCE METHODS, by B. E. Hubbard. Sept. 1961, 27p. incl. refs. (Technical note no. BN-260) (AFOSR-3155) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)228 and Naval Ordnance Lab.) Unclassified

Also published in Arch. Rational Mech. Anal., v. 10: 171-179, 1962.

For abstract see item no. 1480, Vol. V.

1599

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

HARMONIC FUNCTIONS IN FOUR VARIABLES WITH ALGEBRAIC AND RATIONAL P_4 ASSOCIATES, by R. P. Gilbert. July 1962, 27p. incl. refs. (Technical note no. BN-294) (AFOSR-3490) (AF 49(638)228) AD 283840 Unclassified

Also published in Pacific Jour. Math., v. 13: 79-96, Spring 1963.

Integral representations for harmonic functions in 4 variables are investigated by means of an operator bearing close resemblence to 1 Whittaker-Bergman operator. The cases where the P_4 associate is algebraic is considered by means of the theory of double integrals on algebraic 3-folds. When the P_4-associate is rational one obtains particularly interesting representations by considering the connections with Weierstrass integrals of the first, second, and third kinds defined over a Riemann surface. In addition, a residue theorem is given for a class of harmonic vectors, $U = (u_1, u_2, u_3, u_4)$ satisfying the relations which are analogous to one vanishing of one curl and divergence is three-dimensions. (Contractor's abstract)

1600

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON A RESULT OF HADAMARD CONCERNING THE SIGN OF THE PRECESSION OF A HEAVY SYMMETRICAL TOP, by J. B. Diaz and F. T. Metcalf. Apr. 1962, 3p. (Technical note no. BN-285) (AFOSR-3831) (AF 49-(638)228) AD 286084 Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 669-670, Aug. 1962

Hadamard's proof concerning the sign of the precession of a heavy symmetrical top employed the theory of residues of functions of a complex variable. The present authors, using only definite integrals and simple inequalities, obtain the same result in an elegant, direct manner.

1601

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A PRIORI BOUNDS ON THE DISCRETIZATION ERROR IN THE NUMERICAL SOLUTION OF THE DIRICHLET PROBLEM, by J. H. Bramble and B. E. Hubbard. Aug. 1962, 39p. incl. refs. (Technical note no. BN-296) (AFOSR-4213) (AF 49(638)228) AD 290322 Unclassified

Also published in Contrib. Differential Equations, v. 2: 229-252, 1963.

Explicit a priori bounds are obtained on the discretization error for a certain finite difference analogue of the Dirichlet problem for Poisson's equation. The bounds involve square integrals of various derivatives of the data (including the curvature of the boundary which is considered as data). The exhibit $O(h^2)$ asymptotic behavior where h is the mesh constant associated with a square grid.

1602

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON A RESULT OF HADAMARD CONCERNING THE SIGN OF THE PRECESSION OF A HEAVY SYMMETRICAL TOP, by J. B. Diaz and F. T. Metcalf. Apr. 1962, 3p. (Technical note no. BN-285) (AFOSR-4214) (AF 49-(638)228) Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 669-670, Aug. 1962.

For abstract see item no. 1600, Vol. VI.

1603

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

[ON ALMOST PERIODIC SOLUTIONS OF A CLASS OF ELLIPTIC EQUATIONS] Sulle soluzioni quasi periodiche di una classe di equazioni ellittiche, by A. Weinstein. [1962] [4]p. (Technical note no. BN-279) (AFOSR-J11) (AF 49(638)228) Unclassified

Also published in Atti. Accad. Naz. Lincei Rend., Classe Sci. Fis. Mat. e Nat., v. 32: 863-866, June 1962.

For abstract see item no. 1591, Vol. VI.

1604

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON A MEAN-VALUED THEOREM OF THE DIFFERENTIAL CALCULUS OF VECTOR-VALUED FUNCTIONS, AND UNIQUENESS THEOREMS FOR ORDINARY DIFFERENTIAL EQUATIONS IN A LINEAR-NORMED SPACE, by A. K. Aziz and J. B. Diaz. [1961] [19]p. incl. refs. (AFOSR-J426) (AF 49(638)228) AD 407247 Unclassified

Presented at meeting of the Amer. Math. Soc., Jan. 25, 1961.

Also published in Contrib. Differential Equations, v. 1: 251-269, 1963.

For abstract see item no. 1491, Vol. V.

1605

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

BOUNDS FOR SOLUTIONS OF SECOND ORDER ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS, by J. H. Bramble and L. E. Payne. Apr. 1961, 53p. incl. refs. (Technical note no. BN-237) (AFOSR-J587) (AF 49(638)228) Unclassified

Also published in Contrib. Differential Equations, v. 1: 95-127, 1963.

For abstract see item no. 1470, Vol. V.

1606

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

UPPER AND LOWER BOUNDS FOR THE APSIDAL ANGLE IN THE THEORY OF THE SPHERICAL PENDULUM, by J. B. Diaz and F. T. Metcalf. [1962] [9]p. incl. diagrs. refs. (AFOSR-J618) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)228 and Naval Ordnance Lab.) AD 414073 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: 127-135, 1962.

A simple method is developed for obtaining upper and lower bounds for the apsidal angle which occurs in the theory of the spherical pendulum. This method is employed to give a quick derivation of the well-known

lower and upper bounds of Puiseux and Halphen, respectively, for the apsidal angle. The same method also yields readily the extension of Puiseux's lower bound discovered by W. Kohn. An advantage of the present method is the simplification which arises from eliminating the need for contour integration. The sharpness of the bounds is also demonstrated. (Contractor's abstract)

1607

[Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.]

POINTWISE BOUNDS IN THE FIRST BIHARMONIC BOUNDARY VALUE PROBLEM, by J. H. Bramble and L. E. Payne. [1962] [9]p. incl. refs. [AF 49(638)228] Unclassified

Published in Jour. Math. and Phys., v. 42: 278-286, Dec. 1963.

A priori bounds are derived for the solution of $\wedge\Delta u = F$ in R, $u = f$ on C, $\partial u/\partial n = g$ on C, where R is a bounded 2-dimensional region with a piecewise continuously differentiable boundary C. The authors state that their results extend easily to n dimensions. Let B be any biharmonic function in R whose gradient is square integrable on C. By applying several known inequalities for harmonic and biharmonic functions, a bound for $\int_R B^2\,dv$ in terms of B and its first derivatives on C is obtained. By combining this inequality with the meanvalue theorem for biharmonic functions the authors arrive at explicit pointwise bounds for the solution u of the original boundary-value problem, as well as for the first derivatives of u and Δu. These inequalities involve, in addition to the data and the distance from the boundary, an arbitrary smooth function φ in $R + C$. A good choice of φ, obtainable, for instance, by Ritz's method, will improve the estimates. The inequalities degenerate as the boundary is approached.

1608

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ELECTRICAL CONDUCTIVITY OF PARTIALLY IONIZED GASES, by A. C. Pipkin. Apr. 1959, 30p. incl. table. (Technical note no. BN-170) (AFOSR-1674) (AF 49-(638)401) Unclassified

Also published in Phys. Fluids, v. 4: 154-158, Jan. 1961. (Title varies)

For abstract see item no. 989, Vol. III.

1609

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE WAVE MOTIONS OF SMALL AMPLITUDE IN A FULLY IONIZED PLASMA. PART IV. WITH AN ARBITRARY APPLIED MAGNETIC FIELD, by D. G. Weir. Jan. 1962 [24]p. incl. diagrs. (Technical note no. BN-271) (AFOSR-2144) (AF 49(638)401) AD 271471 Unclassified

The dispersion relation of waves in a fully ionized plasma under a uniform magnetic field of arbitrary orientation has been derived from the 2 fluid theory which is a quartic equation for λ^2, λ being the complex wave number. Various cases have been examined. It has been shown that the roots for λ^2 are all real for an ideal plasma. In the low frequency range 3 of the roots for λ^2 are positive, corresponding to undamped waves, while one root is negative, leading to a damped exponential wave. One of the positive roots changes into a negative root at frequencies higher than the ion cyclotron frequency, calculated from the component of the magnetic field in the direction of the wave propagation. Another root changes sign when the frequency becomes higher than the electron cyclotron frequency calculated for the same component of the magnetic field. At very high frequencies all 4 roots are positive. The interaction between basic waves due to the external magnetic field at very high frequencies is negligible. (Contractor's abstract)

1610

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME CONSIDERATIONS ON RADIATION MAGNETOGASDYNAMICS, by S. I. Pai. Apr. 1962 [29]p. incl. diagrs. (Technical note no. BN-286) (AFOSR-2874) (AF 49(638)401) AD 276135 Unclassified

The fundamentals of radiant energy transfer and their effects on the gasdynamics are first discussed. The basic equations of radiation magnetogasdynamics are then derived. These equations are simplified under the assumption of local thermodynamic equilibrium. Two special cases have been worked out. One is the case of small mean free path of radiation and the other is the 2 dimensional steady flow in the presence of a straight opaque wall. In the latter case, further simplifications have been made by assuming boundary layer flow and gray gas approximation.

1611

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A NEW APPROACH TO TRANSPORT PROBLEMS IN FULLY IONIZED PLASMAS - II. by S. F. Edwards and J. J. Sanderson. June 1962 [15]p. (Technical note no. BN-293) (AFOSR-3018) (AF 49(638)401) AD 282194 Unclassified

Also published in Plasma Phys., Accelerators, Thermonuclear Research, v. 4: 409-413, 1962.

A general method is given for solving the equations governing the propagation of 1 and 2 particles through a fully ionized, near-equilibrium plasma. The coefficient

of electrical conductivity is determined variationally with the exclusion and inclusion of plasma oscillation effects. Without plasma oscillations the result agrees within about 3% with the values of Cowling and of Spitzer and Härm. The effect of plasma oscillations is small the correction being about 0.4%. (Contractor's abstract)

1612

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE CURVATURE OF SHOCK FRONTS IN SHOCK TUBES, by P. C. T. de Boer. July 1962 [151]p. incl. diagrs. refs. (Technical note no. BN-297) (AFOSR-3790) (AF 49(638)401) AD 286675 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 260, Apr. 23, 1962. (Title varies)

Also published in Phys. Fluids, v. 6: 962-971, July 1963.

Hartunian's theory for the curvature of a shock wave progressing into quiescent gas near a wall has been extended to the case of 2 parallel walls and to that of a circular tube. The axial extent of the curved shock in these cases amounts to 0.760 and 0.783, respectively, of Hartunian's single-wall result. The correction arising when the boundary layer has a finite effective length L has been calculated. Another correction involves the length a of a region of pressure adjustment immediately behind the foot of the shock. With suitable assumptions about the magnitudes of L and a, the results are in good agreement with Duff and Young's experimental data. The shock curvature measured by Lin and Fyfe is appreciably larger than found from the method described.

1613

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

NEW TECHNIQUES FOR THE VACUUM-ULTRAVIOLET, by T. D. Wilkerson and R. Lincke. Dec. 1962 [9]p. incl. diagrs refs. (Technical note no. BN-307) (AFOSR-4408) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)401, National Aeronautics and Space Administration, and National Science Foundation) Unclassified

Simple and inexpensive methods have been developed for converting conventional photomultipliers into vacuum-uv-sensitive devices. The ranges of sensitivity are useful for many plasma experiments, both in space and in the laboratory. The bandwidths are sufficiently narrow as to improve the quality of both dispersive and non-dispersive radiation measurements.

1614

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

PHENOMENA SURROUNDING HIGH SPEED FLIGHT, by J. M. Burgers. Final rept. July 1, 1958-Sept. 30, 1962, Dec. 6, 1962, 43p. incl. refs. (AFOSR-4536) (AF 49(638)401) Unclassified

The work done under the contract refers to various aspects of gas dynamics and kinetic theory. The topics of chief interest are: (1) ionization phenomena connected with a shock wave; (2) precursor signals observed in front of a shock; (3) breaking of the shock tube diaphragm; (4) shock curvature; (5) geometrical optics; (6) density distribution of electrons and ions just ahead and just behind a shock front; (7) the relaxation phenomena in carbon dioxide; and (8) interaction of a shock of high Mach number with a magnetic field.

1615

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A NEW APPROACH TO TRANSPORT PROBLEMS IN FULLY IONIZED PLASMAS - II, by S. F. Edwards and J. J. Sanderson. [1962] [5]p. (AFOSR-J438) (AF 49(638)401) AD 407258 Unclassified

Also published in Plasma Phys., Accelerators, Thermonuclear Research, v. 4: 409-413, 1962.

For abstract see item no. 1611, Vol. VI.

1616

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME CONSIDERATIONS ON THE FUNDAMENTAL EQUATIONS OF ELECTRO-MAGNETO-GASDYNAMICS, by S. I. Pai. [1958] [14]p. incl. refs. (AF 49(638)401) Unclassified

Published in Calcutta Math. Soc., Golden Jubilee Commemoration Volume, Pt. 1: 235-248, 1958-1959.

The fundamental equations of the flow problems of electrically conducting fluids, particularly of ionized gases (plasma), are discussed first, then the magneto-gasdynamics approximations are derived. The general properties of fundamental equations of magnetogasdynamics are discussed. The most important parameters of magnetogasdynamics, the magnetic pressure number and the magnetic Reynolds number, are defined. Their influence on the flow field is considered. The magneto-gasdynamics approximations are then re-examined. The generalization of the analysis of magnetogasdynamics to electromagnetogasdynamics, radiation-magnetogasdynamics and magnetogasdynamics in a gravitational field are briefly treated. Finally, the 1-dimensional flow problems of magnetogasdynamics have been treated in some detail which include the characteristics of 1-dimensional unsteady flow and the steady flow through a nozzle.

1617

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

INFLUENCE OF SHOCK-FRONT CURVATURE ON MEASUREMENTS USING THE SCHLIEREN-PHOTOTUBE TECHNIQUE (Abstract), by P. C. T. de Boer. [1962] [1]p. [AF 49(638)401] Unclassified

Presented at meeting of the Amer. Phys. Soc., Oklahoma U., Norman, Nov. 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 499, Aug. 28, 1963.

Some essential limitations are considered in the application of the schlieren-phototube technique to the study of relaxation phenomena behind shock waves. The resolving power is limited by Fresnel diffraction occurring in the edges of the light beam. Another limitation arises from the curvature of the shock wave. Expressions have been derived for the amplitude of the signal arising from the curved shock front as a function of the angle between light beam and shock tube. There is a marked dependence of amplitude on angle, and this was used experimentally for the alignment of the direction of the light beam. The instrumentation was calibrated by displacing the knife edge over a known distance and measuring the resulting signal. Measurements on shock fronts in argon and helium indicated that the axial extent of the curved shock at high initial pressures was approximately constant and that variations in shock tilt were negligible. There is evidence that the axial extent was determined mainly by irregularities in the shock-tube surface just before the test section.

1618

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

NEW DETECTOR FOR THE VACUUM ULTRAVIOLET, by R. Lincke and T. D. Wilkerson. [1962] [3]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)401] and National Science Foundation) Unclassified

Published in Rev. Scient. Instr., v. 33: 911-913, Sept. 1962.

A new method is described for detecting vacuum uv radiation. This radiation is converted to visible light in 2 steps, the first being creation of photoelectrons at a high voltage cathode, the second consisting of stopping these electrons in a scintillator at ground potential. The visible scintillations are detected with a standard photomultiplier. The system has been compared with a sodium salicylate detector, using a vacuum uv monochromator and a steady light source. Spectral lines between 500 and 1300A have readily been recorded. Compared to other systems the new detector offers a number of advantages which are discussed. Preliminary results for pulsed light sources indicate that the method is also useful for studying phenomena whose time scales are of the order of 1 μ sec.

1619

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

NEW VACUUM-ULTRAVIOLET DETECTOR (Abstract), by R. Lincke and T. D. Wilkerson. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)401] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 259, Apr. 23, 1962.

The detector converts vacuum-uv radiation into visible light which is recorded by conventional methods. Vacuum uv falls on a gold cathode held 15 kv below ground potential. Resulting photoelectrons accelerate into a grounded plastic scintillator covered with a thin aluminum coating. Visible-light output passes through a window into a high-grain photomultiplier outside the vacuum vessel. Spectral lines from 500 to 1300A have readily been recorded by this method. Longer wavelengths are not observable because of the quantum-yield cutoff of gold and the opacity of the scintillator coating. Scattered-light response is, therefore, negligible compared to sodium-salicylate detectors. Comparison spectra are presented. The new method avoids surface-contamination effects of open vacuum photomultipliers and current limitations of magnetic, resistance-strip multipliers. Sensitivity is comparable to other methods for wavelengths shorter than 1200A. Applications appear likely for space experiments, as well as for laboratory studies of steady or transient discharges.

1620

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

VIBRATIONAL RELAXATION IN CARBON DIOXIDE. II, by W. J. Witteman. [1962] [7]p. incl. diagrs. tables. [AF 49(638)401] Unclassified

Published in Jour. Chem. Phys., v. 37: 655-661, Aug. 1, 1962.

The vibrational energy rate of approach to thermal equilibrium of suddenly heated CO_2 gas has been studied by using a shock tube and the integrated schlieren method for density measurements. The experimental results agree fairly well with the predicted direct excitation of bending mode and indirect excitation of valence mode in the temperature range 440°-816°K. The measured relaxation times for the direct excitation process range from 3.75 μ sec at 440°K to 0.64 μ sec at 816°K. The effects of impurities through leakage in the tube can be considered negligible. The average temperatures of the measured bending energies are slightly higher than the corresponding temperatures of the valence energies, which indicates that the time constant of the indirect excitation process is at least one order of magnitude smaller. (Contractor's abstract)

1621

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

WAVE MOTION IN A FULLY IONIZED PLASMA UNDER A UNIFORM MAGNETIC FIELD OF ARBITRARY ORIENTATION (Abstract), by S. I. Pai and D. G. Weir. [1962] [1]p. [AF 49(638)401] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 13, Jan. 24, 1962.

The dispersion relation of waves has been derived from 2-fluid theory which is a quartic equation for λ^2, λ being the complex wave number. Various cases have been examined. It has been shown that the roots for λ^2 are all real for an ideal plasma. In the low-frequency range 3 of the roots for λ^2 are positive, corresponding to undamped waves, while 1 root is negative, leading to a damped experimental wave. One of the positive roots changes into a negative root at frequencies higher than the ion-cyclotron frequency, calculated from the component of magnetic field in the direction of the wave propagation; another root changes sign when the frequency becomes higher than the electron-cyclotron frequency calculated for the same component of the magnetic field. At very high frequencies all 4 roots are positive. The interaction between basic waves due to external magnetic field at very high frequencies is negligible.

1622

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

PROGRESSIVE DEFORMATION OF A CURVED VORTEX FILAMENT BY ITS OWN INDUCTION, by F. R. Hama. [1962] [7]p. incl. diagrs. (AFOSR-3678) (AF 49(638)-645) Unclassified

Published in Phys. Fluids, v. 5: 1156-1162, Oct. 1962.

Progressive 3-dimensional deformation of an initially parabolic, plane curved vortex due to its own induction is numerically obtained in this paper by the use of the localized-induction concept instead of through the full Biot-Savart law. It is shown that after the region near the vertex rises up from the plane of the initial orientation, a helical deformation takes place on the legs of the parabola. The helix, which rotates in the direction opposite to the circulatory rotation around the vortex filament, is found to travel away toward the far ends of the parabola as the vertex keeps rising up, while increasing the amplitude and extent of the helical deformation. Similar computations also carried out with a hyperbolic initial shape resulted in essentially the same conclusions as the parabola but with much better numerical stability, as well as with an exponential initial configuration, which grew into somewhat more complicated patterns, yet maintained the essential feature of the helical deformation.

1623

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME OBSERVATIONS OF TRANSITION FLOW IN AXIALLY SYMMETRIC BOUNDARY LAYERS, by F. R. Hama. [1962] [14]p. incl. illus. (AFOSR-3692) (AF 49(638)645) Unclassified

Direct surveillance of the vortex pattern caused by a ring-shaped trip is made on 1-in. and 1/2-in. circular cylinders and on a 30° cone in a water tank. Over the cylinders, the boundary-layer thickness is approximately up to the radius of the cylinders. Ring-shaped vortices are shed and deformed into vortex loops in much the same manner as on a flat plate. On the cone, the ring-shaped vortices are stretched and then inevitably deformed into vortex loops, showing that a mere stretching is not a sufficient mechanism for the creation of a turbulence spot. A mechanism of the final breakdown from the vortex loop is tentatively proposed. (Contractor's abstract)

1624

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

AN EXPERIMENTAL STUDY OF THE THREE DIMENSIONALITY OF THE FLOW AROUND A CIRCULAR CYLINDER, by G. E. Mattingly. June 1962, 67p. incl. illus. diagrs. refs. (Technical note no. BN-295) (AFOSR-3873) (AF 49(638)645) AD 285632 Unclassified

The flow around a circular cylinder of a finite length, with its symmetrical axis oriented normal to the direction of motion, is investigated by means of dye techniques in a water tank. The flow around the cylinder including the end effect is described during the period of accelerated motion preceding a constant velocity as well as during the flow at constant velocity. The Reynolds number is varied in the range $10^{4-} < Re < 10^{5+}$ for 3 cylinders which are 6-, 4-, and 1-in. diam and 30-in. long. The flow around the cylinders is found to be strongly 3-dimensional, and a plausible explanation of the origin of the 3-dimensionality is put forward. (Contractor's abstract)

1625

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

AN EXPERIMENTAL STUDY OF THE THREE DIMENSIONALITY OF THE FLOW AROUND A CIRCULAR CYLINDER, by G. E. Mattingly. June 1962, 67p. incl. illus. diagrs. refs. (Technical rept. no. BN-295) (AFOSR-3903) (AF 49(638)645) AD 285632 Unclassified

For abstract see item no. 1624, Vol. VI.

1626

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

PROGRESSIVE DEFORMATION OF A PERTURBED LINE VORTEX FILAMENT, by F. R. Hama. [1962] [9]p. incl. diagrs. refs. (AFOSR-J1046) (AF 49(638)645) AD 418298 Unclassified

Also published in Phys. Fluids, v. 6: 526-534, Apr. 1963.

When a straight 2-dimensional vortex filament, which is laid on the x axis, is perturbed by a 3-dimensional distortion, it deforms progressively by its own induction. The progressive deformation is numerically obtained in this paper for a localized distortion $y = a \exp(-x^2)$ and for a periodic distortion $y = 2a \cos[\frac{1}{2}(\pi x)]$, a being the amplitude relative to the lateral extent of the distortion. When a is small, the Gaussian distortion causes a helical deformation which first moves in and then moves away toward far ends along the vortex filament, whereas the central portion where the disturbance was originally located, subsides and straightens. The plane of the sinusoidal distortion simply rotates in the direction opposite to that of the translation of fluid in the undisturbed vortex. The retrograde rotation is the same as that formulated by Kelvin. For these cases of small amplitude, a linearized theory is also put forward. When a^2 is large compared with unity, on the contrary, a nonlinear effect comes in, causing higher-order deformations to take place in both cases near the tip of the distorted pattern. This substantiates in part the author's experimental observation of the progressive deformation of a vortex loop in the final stage of boundary-layer transition. A possible mechanism of 3-dimensional amplification of initially small perturbation in a shear flow is also discussed. (Contractor's abstract)

1627

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

INVESTIGATION OF AXIAL FLOW COMPRESSOR BY ELECTRIC SPARK TECHNIQUE, by Y. Kageyama. 1961, 55p. incl. illus. diagrs. tables, refs. (AFOSR-4165) (AF AFOSR-61-3) Unclassified

The electric spark technique was applied to an investigation of the air flow in an axial flow compressor. The results confirmed that this technique is available for the investigation of blade performance. Specifically, this experiment involved measurements of the boundary layers on the compressor blade, 3-dimensional flow pattern and instantaneous wake patterns behind rotor blades at design point operation. In addition, stall investigations were conducted under variable conditions. It was confirmed that the 3-dimensional effect increased, if solidity increased, and the direction of 3-dimensional flow on the rotor blade was from hub to tip. The spark technique permitted a more precise investigation of the flow on the blades of axial flow compressor, which should lead to greater efficiency, particularly at high speed operation.

1628

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

COMPOSITION FORMULAS IN GENERALIZED AXIALLY SYMMETRIC POTENTIAL THEORY, by R. P. Gilbert. Oct. 1962, 20p. incl. refs. (Technical note no. BN-298) (AFOSR-4225) (AF AFOSR-62-454) AD 292977 Unclassified

Also published in Jour. Math. and Mech., v. 13: 577-588, July 1964.

A composition or quasi-multiplication is introduced for solutions of the generalized axially symmetric potential theory equation (GASPT), so that the composition of 2 solutions is always a solution. Analogues to the Cauchy integral formulas are developed and stated in terms of composition formulas. In addition the composition algebra is investigated for certain classes of functions.

1629

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON A FINITE DIFFERENCE ANALOGUE OF AN ELLIPTIC BOUNDARY PROBLEM WHICH IS NEITHER DIAGONALLY DOMINANT NOR OF NON-NEGATIVE TYPE, by J. H. Bramble and B. E. Hubbard. Dec. 1962 [22]p. incl. refs. (Technical note no. BN-305) (AFOSR-4302) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-454 and National Science Foundation) AD 293887 Unclassified

Also published in Jour. Math. and Phys., v. 43: 117-132, June 1964.

A study of a particular $O(h^4)$ finite difference analog of a 2 point boundary problem for the Sturm-Liouville equation is presented. This analog violates the usual properties of diagonal dominance and being of non-negative type at every interior mesh point. It is shown, however, that for the mesh size h taken sufficiently small a maximum principle is valid and that the discretization error is $O(h^4)$. It is further shown that the point Jacobi iteration method diverges while the forward-backward Gauss-Seidel method converges. (Contractor's abstract)

1630

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

OPERATORS WHICH GENERATE HARMONIC FUNCTIONS IN THREE VARIABLES, by R. P. Gilbert. Dec. 1962 [22]p. incl. refs. (Technical note no. BN-306) (AFOSR-4374) (AF AFOSR-62-454) AD 294987 Unclassified

Also published in Scripta Math., v. 27: 141-152, 1964.

A new construction of the Bergman-Whittaker operator is presented. Another operator, which transforms

functions of 2 complex variables into harmonic functions in 3 variables is introduced along with its inverse operator. A theorem connecting the singularities of analytic functions with those of harmonic functions is given with an illustration. These methods are extended to a class of singular hyperbolic equations. (Contractor's abstract)

1631

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

LAMINAR JET MIXING IN RADIATION GASDYNAMICS, by S. I. Pai. [1962] [6]p. (AFOSR-64-0139) (AF AFOSR-63-141) AD 431071 Unclassified

Also published in Phys. Fluids, v. 6: 1440-1445, Oct. 1963.

The fundamental equations of a laminar jet mixing region with thermal radiation are first derived, including both radiation stresses and radiation heat flux. Then the cases of both small and finite mean free path of radiation flux number are introduced and discussed. The radiation effects are to reduce the maximum temperature in the mixing region and to increase the spread of the thermal mixing region. Explicit formulae to calculate these effects are given. (Contractor's abstract)

1632

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

EFFECTS OF GLUCOSE AND OXYGEN DEPRIVATION ON FUNCTION OF ISOLATED MAMMALIAN RETINA, by A. Ames, III and B. S. Gurian. [1962] [18]p. incl. diagrs. refs. (AFOSR-64-0174) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-98 and National Institute of Mental Health) AD 432739 Unclassified

Also published in Jour. Neurophysiol., v. 26: 617-634, July 1963.

Light-evoked compound action potentials were recorded from the optic nerve of isolated rabbit retina, maintained at 30°. The evoked potentials disappeared after 4 min of anoxia, but when O_2 was resupplied recovery was rapid and complete even after 60 min deprivations. Without glucose, response amplitude fell to 40% in 4 min and to 0% in 60 min, about 66% of the initial amplitude was recoverable after 60 min deprivations. Recovery after simultaneous deprivation of O_2 and glucose was markedly delayed but finally as complete as after deprivation of glucose alone. Elevating the temperature 7° reduced by threefold the duration of the combined deprivation that could be reversibly sustained. Effects of reducing O_2 and glucose to intermediate levels and of adding other nutrients were also examined.

1633

Massachusetts General Hospital. Neurophysiolcgical Lab., Boston.

POSSIBLE PHYSIOLOGICAL BASES FOR ANIMAL NAVIGATION WITH SPECIAL REFERENCE TO INERTIAL GUIDANCE NAVIGATION SYSTEMS (Abstract), by J. S. Barlow. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-98], Office of Naval Research, and Signal Corps) Unclassified

Published in Internat'l. Biophys. Cong., Stockholm (Sweden) (July 31, 1961-Aug. 4, 1961), Abstracts of Contributed Papers, 1961, p. 138.

The phenomenon of animal navigation has thus far escaped a complete explanation in physiological terms. That return of animals from a distant point might be accomplished by means of a memory of every twist and turn of the outgoing path has long been entertained. Experiments in the past to test this hypothesis have however appeared to yield negative results, although upon closer inspection these experiments are perhaps not absolutely conclusive. Over short distances observations obtained by Beritoff indicate that for man, cats, and dogs, the vestibular apparatus is of great importance for spatial orientation and navigation. These considerations are discussed in relation to known physiology of the vestibular apparatus, biological clocks, and reports on experimental observations on navigation by animals and by man (particularly with deficites of the vestibular apparatus). Suggestions are advanced for further investigations in which predictions that are possible can be subjected to experimental test.

1634

Massachusetts General Hospital. Neurophysiological Lab., Boston.

NORMAL AND ABNORMAL OSCILLATORY PHENOMENA IN THE ELECTRICAL ACTIVITY OF THE BRAIN, by M. A. B. Brazier. [1962] [8]p. incl. illus. diagrs. (In cooperation with Massachusetts Inst. of Tech., Cambridge and Harvard U. Medical School, Cambridge, Mass.) (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 Institutes of Health) Unclassified

Published in Neural Physiopathology: Some Relationships of Normal to Altered Nervous System Activity, ed. by R. G. Grenell, New York, Harper and Row, 1962, p. 258-265.

Normal and abnormal oscillatory phenomena are studied by means of an automatic averaging technique which emphasizes only those potential swings that are phase-locked to the stimulus and averages out the background activity that is only randomly related to the incidence of the stimulus. Normal subjects were stimulated photically and the results are presented in the form of autocorrelations of the electroencephalogram. There is evidence for some neuronal activity persisting

as an alpha rhythm not paced by the flash. In another set of experiments performed on normal subjects the photically induced oscillations are found to have a different frequency from the alpha oscillations. The slight difference in frequency of the 2 autocorrelations may be due to the increased alertness of the subject while being flashed. A disruption can be found in disease states that affect this system. For example, the autocorrelogram of a patient who had a cerebrovascular accident in the right hemisphere did not detect any abnormality in the resting EEG, but the use of a flash revealed a normal primary response but an absent evoked oscillation. Finally, the response to auditory stimuli on abnormal nervous activity was illustrated by a clinical case in which the patient suffered attacks which were in some ways psychomotor in type, but which were characterized by her hearing jazz music. Such a case suggests that the neuronal mechanism responsible for further processing of the message after its initial arrival at the receiving cortex was disordered to the extent of losing its oscillatory response to a stimulus and of producing abnormal sensations of sound in the absence of input from the peripheral auditory mechanisms.

1635

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

SUBSONIC FLUTTER OF PANELS ON CONTINUOUS ELASTIC FOUNDATIONS—EXPERIMENT AND THEORY, by J. Dugundji, E. Dowell, and B. Perkin. Apr. 1962 [79]p. incl. illus. diagrs. (ASRL-TR-74-4) (AFOSR-3057) (AF 49(638)219) AD 278235 Unclassified

The subsonic aeroelastic stability of a 2-dimensional panel resting on a continuous elastic foundation was investigated both experimentally and theoretically. Experimentally, tests were conducted on a 104-in. x 24-in. x 0.0018-in. rectangular aluminum panel in a low-speed wind tunnel. Definite flutter of a travelling wave type was observed. Films and oscillograph records were taken. Theoretically, a finite panel, 2 mode, standing-wave analysis was shown to give essentially the same behavior as the infinite panel, travelling-wave analysis of Miles for this panel on an elastic foundation. Although a mild, divergence-type instability exists for these panels, the dominant instability was shown to be of a travelling wave, flutter type. The role of additional internal damping was investigated and found to have an interesting destabilizing effect between the divergence and flutter speeds. Comparison of experiment and theory showed good agreement in the prediction of the flutter speed and wave-length, but rather poor agreement in the wave speed and frequency at flutter. This discrepancy was attributed to various limitations in the test set-up as well as to the general difficulty of predicting the wave speed and frequency as accurately as the flutter speed. The present investigation should be of interest in problems of hydroelasticity, axially symmetric cylinders, and inflatable structures at low speeds, as well as to the general problem of panels lying on springy elastic material.

1636

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

PREPARATION OF IDEALIZED TWO PHASE COMPOSITES BY ELECTROPLATING, by R. H. Krock, J. Levy, and L. A. Shepard. Aug. 1962, 15p. incl. illus. diagrs. (ASRL-TR-94-2) (AFOSR-4076) (AF 49(638)-775) AD 287948 Unclassified

Also published in Electrochem. Tech., v. 1: 168-172, Jan.-Feb. 1963. (Title varies)

Two phase composites, whose microstructure consists of steel ball bearings uniformly dispersed in Ag matrix, were prepared by electroplating. Sintering of the composite raft after electroplating removed remaining voids and removed boundaries between particles by grain growth and diffusion. This method is capable of producing a 2 phase composite with careful control of particle size and interparticle spacing, unobtainable by previous methods. (Contractor's abstract)

1637

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

MECHANICAL BEHAVIOR OF THE TWO-PHASE COMPOSITE, TUNGSTEN-NICKEL-IRON, by R. H. Krock and L. A. Shepard. Aug. 1962, 33p. incl. illus. diagrs. table, refs. (ASRL-TR-94-4) (AFOSR-4077) (AF 49(638)775) AD 288915 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 227: 1127-1134, Oct. 1963.

A series of ductile, 2 phase W-Ni-Fe composites, sintered in the presence of a liquid phase, were tested in tension. Identical room temperature stress-strain curves were obtained for specimens containing from 80 to 92 wt-% W (58 to 75 vol-% W particles). The composites exhibited a maximum elongation of 29% at room temperature, and 10.7% at 77°K. The W particles in the composite elongated by the same amount at these temperatures. Single phase alloy specimens matching the composition of the composite matrix showed about one half the flow stress of the composites. The test results demonstrated that the mechanical properties of W-Ni-Fe composites are determined by the W particles alone and are independent of matrix volume fraction or mean free path over the composition range studied. (Contractor's abstract)

1638

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

PLASTIC DEFORMATION OF THIN BRAZED JOINTS IN SHEAR, by C. W. Shaw, L. A. Shepard, and J. Wulff. Nov. 1962, 45p. incl. illus. diagrs. tables, refs. (ASRL-TR-94-3) (AFOSR-4987) (AF 49(638)775) AD 297526 Unclassified

Also published in Trans. Amer. Soc. Metals, v. 57: 94-119, Mar. 1964.

The plastic behavior of the more ductile phase of a 2 phase material was simulated in shear tests on thin silver joints brazed in tubular steel specimens. Both the yield strength and the work hardening rate of the silver were increased by the presence of the rigid interfaces. At 10% strain, the flow stress of the thin joints was 1.5 as great as fine grained polycrystalline silver. Deformations of the silver near the steel interfaces was severely limited across the joint. These effects were postulated to arise from the constraint of slip by the nonyielding interfaces. (Contractor's abstract)

1639

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

PREPARATION OF TWO-PHASE COMPOSITES BY ELECTROPLATING, by R. H. Krock, J. Levy, and L. A. Shepard. Aug. 1962 [5]p. incl. illus. diagrs. (ASRL-TR-94-2) (AFOSR-J823) (AF 49(638)775) AD 413895 Unclassified

Also published in Electrochem. Tech., v. 1: 168-172, Jan.-Feb. 1963.

For abstract see item no. 1636, Vol. VI.

1640

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

SNAPPING PHENOMENA OF ELASTO-PLASTIC CURVED BEAMS UNDER STATIC AND DYNAMIC LOADINGS, by P. T. Hsu and M. M. Chen. Jan. 1962, 55p. incl. diagrs. (ASRL-TR-100-2) (AFOSR-2460) (AF 49(638)985) AD 275779 Unclassified

The snap-buckling problems for an elasto-plastic curved beam under laterally applied static and dynamic loads are investigated. By neglecting the transverse shear and strain-rate effects, the governing equations for various phases of motion are formulated for a simplified model. Elasto-perfectly-plastic materials are considered. Numerical results of the analytic solutions are given in the form of load-deflection relations and phase trajectories for several typical cases. (Contractor's abstract)

1641

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

INSULATING PROPERTIES OF A BOUNDARY LAYER DOWNSTREAM OF A TRANSPIRATION-COOLED REGION, by A. F. Gollnick, Jr. [1962] [4]p. incl. diagrs. refs. (AFOSR-1818) (AF 49(638)245) Unclassified

Also published in [Proc.] Thirtieth annual meeting of the Inst. Aerospace Sciences (Jan. 21-24, 1962), p. 41-44. (IAS Fairchild Fund Paper no. F-30)

A wind tunnel test of a slender cone with a thermally-insulated surface downstream of the injection region is described with reference to the effects of coolant gases, injection rate and reservoir temperature distribution. The laminar data is compared with theory.

1642

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

THE EQUATIONS OF CONSERVATION FOR MULTI-COMPONENT REACTING GAS FLOWS, by F. E. C. Culick. Sept. 1962 [24]p. incl. refs. (Technical rept. no. 48) (AFOSR-4522) (AF 49(638)245) AD 293859 Unclassified

The derivation of the conservation equations for multi-component gas flows is discussed briefly from the point of view of classical kinetic theory and in somewhat greater detail within the principles of the continuum theory. The chief objective is to clarify certain points regarding the diffusion stress tensor which has been introduced elsewhere. (Contractor's abstract)

1643

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

AN EXPERIMENTAL INVESTIGATION OF A TWO-LAYER INVISCID SHOCK CAP DUE TO BLUNT-BODY NOSE INJECTION, by J. R. Baron and E. Alzner. [1962] [10]p. incl illus. diagrs. table. (AFOSR-J391) (AF 49(638)245) AD 408546 Unclassified

Also published in Jour. Fluid Mech., v. 15: 442-448, Mar. 1963.

Blunt-body solutions for supersonic flow usually concern closed body surfaces. A report is made on an experimental investigation of a 2-layer shock cap and the existence of a predictable contact surface separating the layers is indicated. The inner layer was generated by injecting air through a contoured axisymmetric channel on a blunt body so as to simulate a hemispherical contact surface in a Mach number 4.8 flow. Results show the existence of the contact surface and the influence of a range of mass-injection rates upon the displacement of the bow shock and contact surface from the body. (Contractor's abstract)

1644

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

AN INTEGRAL METHOD FOR CALCULATING HEAT AND MASS TRANSFER IN LAMINAR BOUNDARY LAYERS, by F. E. C. Culick. [1962] [11]p. incl. diagrs. refs. (AFOSR-J822) (AF 49(638)245) AD 413946 Unclassified

Also published in AIAA Jour., v. 1: 783-793, Apr. 1963.

An integral method to treat simultaneous heat and mass transfer in a binary-mixture laminar boundary layer when the pressure is uniform is presented. The principal results are 2 pairs to dual integral relations arising from solutions to the integral concentration and energy equations. One pair connects the surface mass transfer rate and surface concentration of injected gas; the other relates surface temperature and heat transfer rate in the presence of mass transfer. Only the cases of helium and air injection into an undissociated air stream are discussed in detail, but the method can be applied to problems involving other gases. The approximate results agree quite well with some numerical solutions and with recent experimental results for which no numerical solutions are available. (Contractor's abstract)

1645

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

THE FLUID MOTION IN A HELIX, by C. J. Bartlett. Apr. 1962 [21]p. incl. diagrs. table. (Technical rept. no. 36) (AFOSR-4639) (AF 49(638)900) AD 289689 Unclassified

An approximate solution for the flow in a helical tube with a square cross section is presented. It is shown that the predicted onset of secondary flow effects is compatible with the measured effect. (Contractor's abstract)

1646

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

THE USE OF AN ELECTROLYTE IN MODEL MHD POWER GENERATORS, by E. E. Covert and D. T. Nowlan. May 1962 [19]p. incl. diagrs. tables. (Technical rept. no. 37) (AFOSR-4769) (AF 49(638)900) AD 289688; AD 407902 Unclassified

The problems associated with the use of electrolytes in scale models for tests of MHD generators are discussed. It is concluded that the Hartmann number and fluid Reynolds number must be matched between the model and the full scale device. (Contractor's abstract)

1647

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

[A STUDY OF THE MECHANICS FOR OPTIMIZATION OF CELESTIAL TRAJECTORIES] Summary rept. Nov. 27, 1962, 3p. (AFOSR-4239) (AF 49(638)363) AD 292729 Unclassified

An attempt was made to define optimum techniques for epoch correction and optimum performance, and to establish boundaries between areas in which different techniques were superior. The simple approach is to change the period of the interceptor vehicle by applying a tangential impulse. In general, the change should be made by a non-tangential impulse, which yields a saving in time and propellant. A brief examination of the effective cross-sectional area of planets was made. The variational calculus and its operational descendants are employed to analyze the problems of trajectory optimization. The orbital escape problem and the soft landing problem are considered. It was found that for landing on the moon, a constant-thrust-angle trajectory is probably the best operational system. A further development in the optimization theory is presented which includes the stochastic nature of a trajectory in the optimization process itself. The procedure is outlined and applied to the case of soft landing on the moon.

1648

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

INTERSECTION THEORY ON QUOTIENTS OF ALGEBRAIC VARIETIES, by R. E. Briney. [1962] [22]p. incl. refs. (AF 18(603)90) Unclassified

Published in Amer. Jour. Math., v. 84: 217-238, Apr. 1962.

Several studies have been made regarding the problem "given 2 cycles Z, Z' carried by an ambient algebraic variety X, a well-defined multiplicity $(C; Z \cdot Z')_X$ can be assigned to each component C of their intersection which is simple on X". However, no general definition has been given for multiplicities of intersection at components which are singular on the ambient variety. A particular case of this problem is considered in the present note. Let a finite group g act as a group of biregular transformations on a nonsingular variety X, and assume that the quotient space $Y = X/g$ is a variety. If elements of g other than the identity have fixed points on X, the variety Y will in general have singularities. An intersection multiplicity $(C; Z \cdot Z')_Y$ for any component C of the proper dimension, $\dim Z + \dim Z' - \dim Y$: when C is simple on Y is defined. A global intersection theory is established, not only on quotients of nonsingular varieties but on those which result from nonsingular varieties after a finite number of repetitions of the process of forming quotients. The precise result is stated as follows: Let Q be the category of all normal varieties Y having a nonsingular normalization in some field K obtainable from $k(Y)$ by a finite sequence of (finite) Galois extensions. Then Q is an intersection category, with an intersection multiplicity which agrees on nonsingular varieties with the usual one.

1649

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

RECIPROCITY THEOREM IN CYCLOTOMIC FIELDS, by N. C. Ankeny. [1962] [8]p. [AF 18(603)90] Unclassified

Published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szegö, C. Loewner and others. Stanford U. Press, 1962, 1. 8-15.

Suppose that p is an odd prime, and denote Q_p the p-adic completion of the rationals and by F the cyclotomic field $Q_p(\xi)$, where ξ is a primitive pth root of unity. In this paper the author obtains a necessary and sufficient condition for α to be a norm from the field $K = F(\alpha^{1/p})$, where α, β are non-zero elements of F. (Math. Rev. abstract, modified)

1650

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

TRIGONOMETRIC POLYNOMIALS AND DIFFERENCE METHODS OF MAXIMUM ACCURACY, by G. Strang. [1962] [8]p. (AFOSR-3695) (AF 49(638)42) Unclassified

Also published in Jour. Math. and Phys., v. 41: 147-154, June 1962.

The fundamental problem in the theory of partial difference approximations to hyperbolic equations is the question of convergence to the true solution through the use of an increasingly fine mesh. This question is examined for those explicit methods of greatest interest, the most accurate ones. The most exact methods prove to be stable under quite resonable restrictions on the mesh ratio. Bernstein's inequality for the derivative of a trigonometric polynomial is applied in the latter half of the paper to establish the connection between 2 standard necessary conditions for convergence. For systems of equations, the reasoning is reversed to obtain a sort of Bernstein theorem for the spectral radius when the polynomial's coefficients are matrices.

1651

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON THE THIRD ENGEL CONDITION, by J. L. Alperin. [1962] 7p. (AFOSR-4108) (AF 49(638)42) Unclassified

In a recent paper, Heineken made a detailed study of groups satisfying the third Engel condition in which he proved that any such group G was locally nilpotent and moreover, if G had no elements of order 2 or 5, then G was in fact nilpotent of class at most 4. Previously, Higgins studied Lie rings satisfying the third Engel condition and showed that any such Lie ring L, of characteristic prime to 2 and 5, was nilpotent of class at most 6. This paper attempts to remove the restrictions indicated by both authors on elements of order 5 and on characteristic prime to 5. However, in order to do this, larger bounds are obtained for the class of nilpotence in both these results. Specifically, the following theorems are proved: (1) Any group satisfying the third Engel condition and which contains no elements of order 2 is nilpotent of class at most 7; and (2) Any Lie ring satisfying the third Engel condition and which is of characteristic prime to 2 is nilpotent of class at most 7.

1652

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON THE OSCILLATIONS AND THE STABILITY OF ROTATING GASEOUS MASSES, by S. Chandrasekhar and N. R. Lebovitz. [1961] [13]p. incl. table, refs. (AFOSR-J727) (In cooperation with Chicago U., Ill.) (AF 49(638)42) Unclassified

Also published in Astrophys. Jour., v. 135: 248-260, Jan. 1962.

The oscillations and the stability of a rotating gaseous mass are considered on the basis of an appropriate tensor form of the virial theorem. On the assumption that the Lagrangian displacement ξ can be expressed in the form $\xi_j = X_{jr}\gamma_r e^{\lambda t}$ (X_{jr} constants), a characteristic equation for λ (of order 18) is derived from the 9 integral relations provided by the virial theorem. An examination of the roots of this characteristic equation enables the enumeration of the properties of all the natural modes of oscillation belonging essentially to harmonics not higher than the second. It is shown that there are 3 principal groups among these modes: a group of 3 modes, each of which exhibits a doublet character; a group of 2 modes, 1 of which becomes neutral at a point where the condition for the occurrence of a point of bifurcation is satisfied and both of which become overstable at a higher angular velocity; and a group which represents the coupling of 2 modes, 1 of which is purely radial and the other of which is purely non-radial in the absence of rotation. In addition to these modes, there are 2 "trivial" modes, 1 of which is neutral and the other of which has a characteristic frequency equal to the angular velocity. (Contractor's abstract)

1653

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

ON THE DISTRIBUTION OF MATTER WITHIN HIGHLY FLATTENED GALAXIES, by A. Toomre. [1962] [8]p. incl. diagrs. tables. (AFOSR-65-0077) (AF 49(638)42) AD 455618 Unclassified

Also published in Astrophys. Jour., v. 138: 385-392, Aug. 15, 1963.

A new mathematical method for deducing, from an arbitrary law of rotation, the equilibrium distribution of mass within a highly flattened, axisymmetric, self-gravitating system, such as a spiral galaxy is presented. An exact and an approximate single integral are developed, each of which gives the required surface mass density explicitly in terms of the rotation function. In

addition, certain conveniently expressible mass distributions are shown to correspond accurately to some fairly realistic functions describing the rotation velocity. The properties of some of these mathematically exact galaxy models are also discussed and intercompared.

1654

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON SUPERPOTENTIALS IN THE THEORY OF NEWTONIAN GRAVITATION. II. TENSORS OF HIGHER RANK, by S. Chandrasekhar and N. R. Lebovitz. [1962] [5]p. (AFOSR-65-0079) (In cooperation with Chicago U., Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and Office of Naval Research) AD 455628 Unclassified

Also published in Astrophys. Jour., v. 136: 1032-1036, Nov. 1962.

In addition to the tensors considered in the earlier paper (item no. 1532, Vol. V) the following tensors are defined and studied:

$$\mathfrak{D}_{ij}(x) = G\int_V \rho(x')\frac{x'_i x'_j}{|x-x'|}\,dx',$$

$$\mathfrak{D}_{ij;k}(x) = G\int_V \rho(x')\frac{(x_i-x'_i)(x_j-x'_j)x'_k}{|x-x'|^3}\,dx', \text{ and}$$

$$\mathfrak{D}_{ijkl}(x) =$$

$$G\int_V \rho(x')\frac{(x_i-x'_i)(x_j-x'_j)(x_k-x'_k)(x_l-x'_l)}{|x-x'|^5}\,dx'.$$

These tensors are useful in problems (such as the stability of the Jacobi ellipsoids) in which it is necessary to examine the effects of perturbations belonging to the third harmonic. (Contractor's abstract)

1655

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

THE POTENTIALS AND THE SUPERPOTENTIALS OF HOMOGENEOUS ELLIPSOIDS, by S. Chandrasekhar and N. R. Lebovitz. [1962] [11]p. (AFOSR-65-0080) (In cooperation with Chicago U., Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)42 and Office of Naval Research) AD 455616 Unclassified

Also published in Astrophys. Jour., v. 136: 1037-1047, Nov. 1962.

Explicit expressions are found for the various potentials and superpotentials of homogeneous ellipsoids.

1656

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON THE OCCURRENCE OF MULTIPLE FREQUENCIES AND BEATS IN THE δ CANIS MAJORIS STARS, by S. Chandrasekhar and N. R. Lebovitz. [1962] [3]p. (AFOSR-65-0081) (In cooperation with Chicago U., Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and Office of Naval Research) AD 455617 Unclassified

Also published in Astrophys. Jour., v. 136: 1105-1107, Nov. 1962.

An explanation is suggested for the occurrence of 2 nearly equal frequencies and associated beats in the light- and velocity-variations of the δ Canis Majoris stars. It is shown that if the ratio of the specific heat γ is 1.6 and the star is rotating, any disturbance will excite 2 normal modes with nearly equal frequencies. (Contractor's abstract)

1657

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON THE OSCILLATIONS AND THE STABILITY OF ROTATING GASEOUS MASSES. II. THE HOMOGENEOUS, COMPRESSIBLE MODEL, by S. Chandrasekhar and N. R. Lebovitz. [1962] [13]p. incl. diagrs. tables. (AFOSR-65-0082) (In cooperation with Chicago U., Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and Office of Naval Research) AD 455620 Unclassified

Also published in Astrophys. Jour., v. 136: 1069-1081, Nov. 1962.

The pulsation frequencies of rotating, gaseous masses of uniform density, i.e., of the Maclaurin spheroids, are found as functions of the angular momentum M and the ratio of the specific heats γ. Numerical calculations for the pulsation frequencies and normal modes are given for $\gamma = 1.3, \frac{4}{3}, 1.4, 1.5, 1.6$, and $\frac{5}{3}$. It is found that the value of γ, at which dynamical instability sets in, is reduced from $\gamma = \frac{4}{3}$ by rotation. It is also found that when $\gamma = 1.6$, the normal modes of oscillation obtained in the limit $M \to 0$ are both very far from being radial. (Contractor's abstract)

1658

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON THE OSCILLATIONS AND THE STABILITY OF ROTATING GASEOUS MASSES. III. THE DISTORTED POLYTROPES, by S. Chandrasekhar and N. R. Lebovitz. [1962] [23]p. incl. tables, refs. (AFOSR-65-0083) (In cooperation with Chicago U., Ill.) (Sponsored jointly

by Air Force Office of Scientific Research under AF 49-(638)42 and Office of Naval Research) AD 455621 Unclassified

Also published in Astrophys. Jour., v. 136: 1032-1104, Nov. 1962.

The theory of the oscillations of rotating gaseous masses, developed in an earlier paper of this series, is applied to determine the effect of a small rotation (Ω) on the fundamental modes of oscillation of a polytrope. The basis for this application is provided by the theory of rotationally distorted polytropes; this theory is reviewed and amplified further to include a discussion of the superpotential. The various tensors expressed in terms of the characteristic frequencies of oscillation, are evaluated for distorted polytropes, appropriately, to the first order in Ω^2. The final results on the effect of rotation on the characteristic frequencies are presented in the form of tables. (Contractor's abstract)

1659

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ANALYTIC FUNCTIONS AND LOGMODULAR BANACH ALGEBRAS, by K. Hoffman. [1962] [46]p. incl. refs. [AF 49(638)42] Unclassified

Published in Acta Math., v. 108: 272-317, 1962.

A generalization of a portion of the theory of analytic functions in the unit disc is presented. The theory to be extended consists of some basic theorems related to the Hardy class $H^p(1 \leq p \leq \infty)$ such as (1) the theorem of Szegö, Kolmogoroff, and Krein on mean-square approximation of 1 by polynomials which vanish at the origin; (2) the theorems of F. and M. Riesz, on the absolute continuity of analytic measures, and on the integrability of $\log |f|$ for f in H^1; (3) Beurling's theorem on invariant subspaces of H^2; and (4) the factorization of H^p functions into products of inner and outer functions. The embedding of analytic discs in the maximal ideal space of a function algebra is also discussed.

1660

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

PULSATIONS OF MACLAURIN SPHEROIDS (Abstract), by S. Chandrasekhar and N. R. Lebovitz. [1962] [1]p. (In cooperation with Chicago U., Ill.) [AF 49(638)42] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 321, Apr. 23, 1962.

In the theory of the adiabatic pulsations of spherical gaseous masses, the formula $\sigma^2 = (\beta\gamma - H)\, W/I$, giving approximately the frequency σ of radial pulsations, is well known. This formula becomes exact in the limit when the density distribution in the unperturbed configuration is uniform. The problem of generalizing this formula to the case of rotating, and hence nonspherical, configurations can be approached from several directions. The approach followed here consists in calculating exactly the pulsation frequencies of rotating masses of uniform density, i.e., of Maclaurin spheroids, as functions of angular momentum and the ratio of specific heats. The principal results are: (1) Rotation has a stabilizing effect; (2) there are 2 pulsation modes of very different character; and (3) the pulsation modes for $\gamma = 1.6$ (approximately) differ strongly from those for which $\gamma \neq 1.6$. The last result modifies and clarifies a previous interpretation of double periods in certain variable stars.

1661

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

ON SHEAR-LAYER INSTABILITY, BREAKDOWN AND TRANSITION, by H. P. Greenspan and D. J. Benney. [1962] [21]p. incl. diagrs. refs. (AFOSR-J187) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)708 and Office of Naval Research) AD 400176 Unclassified

Also published in Jour. Fluid Mech., v. 15: 133-153, Jan. 1963.

The problem of the linear stability of a time-dependent shear flow is investigated and the effects of contraction and expansion of the layer are discussed. Models of flows observed prior to breakdown are constructed and used to investigate the resulting secondary instabilities which are shown to be extremely violent and in essential agreement with recent experiments. In relatively short time, one half period of the primary oscillation, the energy in the secondary disturbance increases by 2 orders of magnitude; the wave-number corresponding to maximum amplification is 5 times that of the primary wave. (Contractor's abstract)

1662

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

A CRITERION FOR THE EXISTENCE OF INERTIAL BOUNDARY LAYERS IN OCEANIC CIRCULATION, by H. P. Greenspan. [1962] [6]p. (AFOSR-J190) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)708 and National Science Foundation) AD 400172 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 2034-2039, Dec. 1962.

The basic objective of this paper is the derivation of a relatively simple criterion for the occurrence of inertial boundary layers in an ocean, with arbitrary shape, whose

interior or primary circulation results wholly, or in part, from an existing wind-stress system.

1663

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge,

SIMILARITY SOLUTIONS FOR THE FLOW INTO A CAVITY, by C. Hunter. [1962] [17]p. incl. diagrs. tables. (AFOSR-64-2554) (AF 49(638)708)
AD 453969 Unclassified

Also published in Jour. Fluid Mech., v. 15: 289-305, Feb. 1963.

An investigation is made into the possible types of similarity solutions that can describe the symmetric flow of a fluid into an empty spherical cavity. The flow is homentropic, and the fluid obeys a perfect gas law $p = K\rho^{\gamma}$. Values of γ in the range $7 \geq \gamma > 1$ are discussed. In this range, it is found that similarity solutions in which the flow accelerates into the cavity exit for $\gamma > \frac{3}{2}$. For these solutions, the radius R of the cavity decreases as the nth power of time measured from the instant at which the cavity disappears. This power n increases monotonically as γ decreases, and attains the value 1 for $\gamma = \frac{3}{2}$. Similarity solutions in which the cavity collapses with constant velocity are given by the value n = 1, and such solutions are possible for all values of γ in the range considered. (Contractor's abstract)

1664

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

INVESTIGATIONS IN GLOBAL ANALYSIS, by I. E. Segal. Final rept. Sept. 16, 1960-June 30, 1962. July 30, 1962, 6p. (AFOSR-3530) (AF 49(638)945)
AD 285302 Unclassified

The research done under this contract has been directed toward the advance of precise understanding of the elusive but fundamental concept of a local quantized field. The main result is the attainment of the key element for the equation $\Box\sigma = F(\sigma)$, under the assumptions that F (a function of a real variable) is smooth, does not grow too rapidly at infinity, and either gives rise to a positive energy or is Lipschitzian. Under these assumptions, a state of the quantized field at one time may be propagated in a clear-cut and rigorous manner to a state at any other time, which is empirically most essential, and determines in practice an arbitrarily close approximation to the S-operator. The quantum field itself has less direct physical significance, and is more complicated mathematically. It can be represented by linear differential operators on the manifold of classical solutions of the given partial differential equation, or in the Lipschitzian case, by derivations of a certain C^*-algebra. In addition, considerable research has been undertaken in analyzing various relevant topics in function space, the mathematical theory of free fields, and the theory of non-linear hyperbolic partial differential equation.

1665

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

A CHARACTERIZATION OF C(X), by K. Hoffman and J. Wermer. [1961] [4]p. (AF 49(638)1036)
Unclassified

Published in Pacific Jour. Math., v. 12: 941-944, Fall 1962.

The purpose of this paper is to prove the following: Theorem. If ReA is closed under uniform convergence, then A = C(X), Corollary 1. If ReA contains every real-valued continuous function on X, then A = C(X), Corollary 2. If A is closed under complex conjugation, then A = C(X). The proof of the theorem proceeds by reducing it to the case when A is anti-symmetric, i.e., every real-valued function in A is constant.

1666

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

THEORETICAL INVESTIGATIONS OF A SUPERSONIC LAMINAR BOUNDARY LAYER WITH FOREIGN-GAS INJECTION, by S. I. Freedman, J. R. Radbill, and J. Kaye. [1962] [11]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1493 and Office of Naval Research)
Unclassified

Published in AIAA Jour., v. 1: 148-158, Jan. 1963.

The phenomena arising from the uniform injection of helium, air, argon, and iodine into the laminar boundary layer of a supersonic stream of air in a tube were investigated theoretically. The partial differential equations describing the energy, mass, and momentum transfers through the boundary layer were obtained, and a series solution was found for the case of uniform injection through the tube wall. The results of the analysis are in the form of axial distributions of wall temperature and recovery factor and of radial distribution of concentration, velocity, static, and stagnation temperatures. The gas mixture was assumed to be a perfect gas. Properties of the mixture were calculated in accordance with the Gibbs-Dalton rule and the mixing rules based on the kinetic theory of dilute gases. Transport properties for pure air were taken from the N. B. S. tabulations. Transport properties for the other gases were calculated by kinetic-theory methods, employing a Lennard-Jones 6-12 model for the interaction potential. The theoretical predictions for the recovery factor along the tube with air or argon injection agree with experimental data to within 1%. The theoretical predictions for helium injection indicate an 8% rise in the recovery factor along the tube, while experiments have shown only a 1% rise. These differences between theory and experiment are attributed to inaccuracies in the approximations to the transport properties of the binary mixtures. (Contractor's abstract)

1667

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

THE THERMODYNAMIC PROPERTIES OF THE PRODUCTS OF H_2-O_2 COMBUSTION AT ELEVATED TEMPERATURES, by W. C. Moffatt, F. D. Skinner, and R. J. Zaworski. [1962] [9]p. incl. diagrs. (AFOSR-3740) (AF 49(638)375) Unclassified

A program has been developed for the 704 computer which yields the compostion and thermodynamic properties of the products of combustion of stoichiometric H_2-O_2 mixtures. The calculations were based on the existence of 6 species in the products: H_2O, H_2, O_2, H, O, and OH, covering temperature and pressure ranges of 1600° to 6000°K and .01 to 1000 atm, respectively. The standard Newton-Raphson iteration procedure was employed to determine the composition, and corrected iterations were performed until the maximum error in any composition was less than 0.1%. The thermodynamic properties were then calculated directly. To facilitate presentation of the data in the form of a Mollier Chart, temperature and pressure were selected as the independent variables. Also, interpolation of this data was carried out to determine the properties for incremental values of density and Z (the ratio of the molecular weights of undissociated and disocciated products) at each temperature. In all cases, the computed values of enthalpy and entropy were found in dimensionless form, permitting the use of any appropriate set of units. The present computation was based on a stoichiometric mixture of H_2 and O_2, but provision was made so that properties and compositions corresponding to other proportions might be readily found. (Contractor's abstract)

1668

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF LAMINAR AND TURBULENT AIR FLOW IN A TUBE WITH AN ENTRANCE MACH NUMBER OF FIVE. by G. A. Brown. May 1960 [254]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 7359-13) (AFOSR-3492) (AF 49(638)442) AD 621242 Unclassified

An investigation was made of the adiabatic flow of air in the entrance region of a tube with an inlet Mach number of about 5. Measurements were made of the static pressure and adiabatic wall temperature along the test section for values of the inlet core diam Reynolds number between 85,000 and 170,000. A special micromanometer was designed to measure static pressure at the low pressures of about 0.03 psia. Small combination probes were developed to measure the profiles in the boundary layers on the tube walls. The measured static pressures, wall temperatures, recovery factors, local friction coefficients, boundary layer profiles, etc. were in excellent agreement with available theoretical predictions for the laminar boundary layer. The results for the turbulent boundary layer location of transition were in good agreement with available data. The experimental data support the following conclusions: (1) When a tube is supplied with a gas directly from a nozzle, a laminar boundary layer will develop on the tube walls with an isentropic core of fluid near the centerline; (2) If the turbulence level and surface roughness are kept low, transition to a turbulent boundary layer will not occur until Reynolds values core length greater than 10^6 are exceeded; (3) When the turbulent boundary layer is formed, the boundary layer fills the tube in a very short distance and the isentropic core disappears; and (4) When a supersonic laminar boundary layer is present which has a fairly thick subsonic portion, the flow in the tube can be affected by variations in the pressure at the tube exit. A solution has been developed for predicting the pressure distribution in the entrance region of a tube when a compressible laminar boundary layer is present and the flow occurs under adiabatic conditions. The predictions from this solution are within ±5% of the predictions from 2 exact solutions which are available and agree well with existing experimental data. (Contractor's abstract, modified)

1669

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF THE ANNULAR INJECTION OF HELIUM INTO A SUPERSONIC AIR CORE, by C. A. Kemper. May 1962 [187]p. incl. illus. diagrs. tables. (AFOSR-3493) (AF 49(638)442) AD 621243 Unclassified

The experimental portion of the investigation included the development of miniaturized boundary-layer instrumentation capable of measuring velocity, temperature, and concentration profiles of the flow. Profiles were obtained at 8- and 16-diam downstream of the tube entrance, wall temperature measurements were obtained at each L/D, and wall static pressures at every 2L/D. Both the wall distributions and the profiles indicate that the flow was laminar and that the main air flow was not physically disturbed by injection except at the highest rates of injection. The wall concentration of He was unity at the tube entrance and decreased to less than 10% by mass at an L/D of 8. The maximum reduction in wall temperature recovery factor was about 6% for the highest rate of He injection. An analysis was developed for the case of annular injection parallel to the main flow of gas at the entrance of a tube. It is assumed that the flow is divided into 3 regions. The first region is an inner boundary layer adjacent to the tube wall which begins growing at the tube entrance and in which the governing equations are solved by simultaneous numerical integrations. The second region is an intermediate boundary layer, corresponding to the injection slot at the tube entrance, in which the equations are solved by an integral method. The third region is a core of the main stream in which it is assumed that the flow is entropic and 1-dimensional. The analytical solutions for the case where air is injected at the main flow conditions agree quite well with experimental data for zero injection and with previous analytical solutions for flow of air in a tube. (Contractor's abstract, modified)

1670

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

THE VARIANCE ON PALMGREN-MINER DAMAGE DUE TO RANDOM VARIATION, by S. H. Crandall, W. D. Mark, and G. R. Khabbaz. Jan. 1962 [22]p. incl. diagrs. table. (AFOSR-1999) (AF 49(638)564) AD 271151 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: 119-126, 1962.

A random stress-history which is proportional to the stationary response of a single-degree-of-freedom vibratory system to wide-band Gaussian excitation is assigned a damage based on the Palmgren-Miner hypothesis and an idealized S-N law. The damage accumulated in time T is a random variable because of the randomness in the number of cycles and the randomness in the amplitudes of the cycles. The mean and variance of the damage are obtained by 2 procedures: one which accounts for both sources of randomness and one which neglects the randomness in the number of cycles contained in the interval. The 2 procedures give the same asymptotic result when the bandwidth shrinks to zero. (Contractor's abstract)

1671

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

ON RANDOM VIBRATION OF SYSTEMS WITH NONLINEAR DAMPING, by G. R. Khabbaz. July 1962 [121]p. incl. diagrs. tables, refs. (AFOSR-3165) (AF 49(638)564) Unclassified

The energy dissipated from a system in motion depends on many factors such as temperature, stress amplitude and type of material. The simplest model is one in which the damping force is linearly proportional to velocity and independent of the oscillation frequency. The response of a single degree-of-freedom model to a stationary white gaussian input was studied. In the model, the restoring force is linearly proportional to the relative motion of mass and support, but in addition to the viscous damping force, there is also a nonlinear damping force. The differential equation of relative motion of such a model is given by:

$\ddot{u} + 2\xi(\dot{u} + \eta \dot{u}^m) + u = F(T)$; the term $\dot{u}^m$ is the nonlinear damping term. If $\eta = 0$, the above equation becomes the differential equation relative motion for the linear system. Various responses of the system, represented by this equation to a stationary white gaussian input have been analyzed. In general, the effect of the nonlinear damping term on the responses of the sytem can be divided into 3 categories: (1) responses unaffected by the small nonlinear damping term such as the expected number of zero crossings; (2) responses slightly affected by the addition of a small nonlinear damping term to the linear system such as the probability distribution densities of displacement velocity and amplitude of motion; and (3) responses affected significantly due to the addition of a small nonlinear damping term such as the average number of crossings, a high level of response per unit time, and the average accumulation of fatigue damage. (Contractor's abstract, modified)

1672

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

THE ENVELOPE OF RANDOM VIBRATION OF A LIGHTLY-DAMPED NONLINEAR OSCILLATOR, by S. H. Crandall. Oct. 1962 [23]p. incl. diagrs. (Rept. no. 201) (AFOSR-4078) (AF 49(638) 564) AD 288025 Unclassified

Presented at Second Conf. on Nonlinear Vibrations, Warsaw (Poland), Sept. 18-21, 1962.

There are several ways in which the envelope of the stationary random response of a lightly-damped oscillator can be characterized. Two characteristics which lead to the same first-order probability distribution for systems with conservative nonlinear restoring forces are described. In such systems, the envelope distributions are in general different from the distributions of peak amplitudes. The Duffing system is used to illustrate these general results. For the special case of a Gaussian oscillator, an envelope characterization has been given by Rice. It is shown that in this case the above envelope characterization has the same first-order distribution as that given by Rice, but that the second-order probability distributions are, in general, different. (Contractor's abstract)

1673

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

EXPERIMENTS WITH A TRANSIENT DC CROSSED-FIELD ACCELERATOR AT HIGH POWER LEVELS, by W. T. Hogan. [1962] [27]p. incl. illus. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)643 and Office of Naval Reserach) Unclassified

Published in Engineering Aspects of Magnetohydrodynamics, Proc. of the Third Symposium, Rochester N. Y. (Mar. 28-29, 1962), New York, Gordon and Breach, 1964, p. 479-505.

Results show that the eddy currents flowing in the gas as the gas leaves the magnetic field region do not appreciably decelerate the flow, even when the magnetic Reynolds number is greater than unity. For these experiments, the total gas dynamical pressure was larger than the magnetic pressure. The measured open circuit voltages were a few per cent lower than the calculated values for a circular channel indicating that no detrimental internal short circuits exist. By apportioning the total current between the test gas and the cooler gases that follow, and using a model that consists of a slug with a constant value of mass acted upon by the Lorentz force associated with the current passing through the test gas, the

momentum and energy can be balanced. On the basis of the above model, the momentum efficiency was about 70% and 50% for the long and short accelerators, respectively. The percentage of electrical energy charged as a loss to the boundary layers decreases with increasing power. The estimate of this loss indicated that it was 25% at a power of 1.0 megawatts and reduced to about 10% at 5 megawatts. The measured increase in electrical conductivity of the accelerated gases is approximately accounted for by ohmic heating.

1674

Massachusetts Inst. of Tech. Dept. of Physics, Cambridge.

STATISTICAL THERMODYNAMICS, by L. Tisza. Final rept. Sept. 30, 1962, 5p. (AFOSR-4233) (AF 49(638)95) AD 292906 Unclassified

The classical thermodynamic theory is extended by constructing 2 theories of irreversibility of strongly coupled systems. These theories, macroscopic thermodynamics of equilibrium (MTE) and statistical thermodynamics of equilibrium (STE), are Gibbsian in the sense that they overlap to a considerable degree with the thermodynamics and the statistical mechanics of Gibbs. However, they have a more rigorous local organization, they are more complete, and have a wider range of agreement with experiment.

1675

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

IMPULSIVE LOADING OF RIGID-PLASTIC CURVED BEAMS, by M. M. Chen, P. T. Hsu, and T. H. H. Pian. [1962] [7]p. incl. diagrs. (AF 49(638)160) Unclassified

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. 2: 1039-1045. 1962.

Dynamic analysis of a rigid-plastic curved beam with axial constraints under impulsive loading is presented. The governing equations for the dynamic equilibrium of the moving hinges for various phases of motion have been formulated. The nonlinear differential equations are then solved by a numerical integration process for a curved beam consisting of 2 straight elements for different initial rises and initial velocities. The results are compared with the case of a rigid-plastic straight beam treated by Symonds and Mentel.

1676

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

APPLICATION OF THE MONTE CARLO METHOD TO HEAT TRANSFER IN A RAREFIED GAS, by J. K. Haviland and M. L. Lavin. [1962] [7]p. incl. diagrs. table. [AF 49(638)207] Unclassified

Published in Phys. Fluids, v. 5: 1399-1405, Nov. 1962.

A Monte Carlo method was developed and applied to the heat transfer between 2 parallel walls in a rarefied gas using the IBM 709 computer. Three solutions were obtained, all at a temperature ratio between the walls of 4:1. One was for hard-sphere molecules at a Knudsen number of 2.0, and 2 were for Maxwellian molecules at Knudsen numbers of 0.53 and 1.64. These results appear to be of sufficient accuracy to differentiate between some of the approximate analytical methods available at present. It is believed that solutions could be obtained to any degree of accuracy, given sufficient time on a high-speed computer.

1677

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

DETERMINATION OF SHOCK-WAVE THICKNESSES BY THE MONTE CARLO METHOD, by J. K. Haviland. [1962] [23]p. incl. diagrs. table, refs. (AFOSR-J1041) (Sponsored jointly by Air Force Cambridge Research Center, and Air Force Office of Scientific Research under AF AFOSR-62-84) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York Academic Press, Suppl. 2, v. 1: 274-296, 1963.(AFOSR-5310)

A Monte Carlo method has been developed for the solution of rarefied gas problems, and has been applied here to the determination of the shock structure in a gas consisting of hard sphere molecules at Mach numbers of 1.5, 2.0, and 3.0. At the 2 lower Mach numbers, the resulting shock widths are in good agreement with the 2-fluid solution by Ziering, but at a Mach number of 3.0, the shock width is closer to the bimodal solution by Mott-Smith. It is concluded that the Monte Carlo method is capable of providing solutions to any desired accuracy, provided that sufficient time is available on a high-speed computer. The method is not restricted to hard sphere molecules, and can be applied to any molecular model with a spherically symmetric force field. (Contractor's abstract)

1678

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

ON PERTURBED BOUNDARY LAYER FLOWS, by J. D. McClure. June 1962 [181] . incl. diagrs. tables, refs. (Rept. no. 62-2) (AFOSR-3494) (AF AFOSR-62-187) AD 283677 Unclassified

The concepts necessary for understanding the character of perturbed boundary layer flows are developed. Attention is primarily directed toward the role of the boundary layer in flows over perturbed surfaces. The theory for the laminar boundary layer with free-stream Mach number ranging from 0 to 2 is first considered. This part of the investigation is largely of an introductory nature,

although several new points are made. The latter concern waves which travel with supersonic phase velocity relative to the free stream as well as the development and comparison of alternate analytical techniques associated with the inviscid solutions of the equations of motion. Some implications and limitations of the theory are discussed. The effects of the boundary layer are further illustrated by the examination of the stability of traveling wave disturbances in the fluid and an adjoining flexible surface. Significant boundary layer effects are found to derive from 1 of 3 or more-or-less distinct causes: (1) the boundary layer thickness is comparable to the scale of the disturbance; (2) the disturbances are similar in nature to those arising in boundary layer instability and can cause resonance phenomena in the fluid; and (3) the disturbances exhibit transonic behavior. The associated difficulties regarding the nature of the mean flow are largely removed by a detailed examination of the turbulent boundary layer over a rigid wavy wall and by correlation of the measured and predicted effects of the boundary layer on the surface pressure. These effects are found to be quite significant for certain geometries. (Contractor's abstract, modified)

1679

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

THE MULTIPLE-CROSSED-BEAM METHOD FOR MEASURING ELECTRON-IONIZATION CROSS SECTIONS, by C. K. Crawford and C. E. Woodward. Nov. 1962, 36p. incl. illus. diagrs. table. (Technical rept. no. 175) (AFOSR-4984) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110, and Air Force Systems Command) Unclassified

A new method for measuring the absolute values of electron-ionization cross sections is proposed. The technique involves intersecting 2 electron beams with a single atomic beam composed of the material to be studied. Pulsing the first electron beam results in an atomic-beam modulation which may be detected by the second electron beam. Ionization cross sections may be determined if the resulting ion currents are measured and the intersection geometries known. The absolute material-flow rate may also be determined. If a mass spectrometer is provided, the technique may be used on atomic beams composed of several constituents. The absolute cross-section values and the flow rates may be calculated separately for each constituent. The pre-ionization mass and the source temperature can also be calculated. The theory for the method has been developed, and suitable experimental apparatus has been built. The technique has been demonstrated using Mg. In its present form, the signal-to-noise ratio is poor, about 2:1, but suggestions are made which would improve it by more than 2 orders of magnitude. More work is required before useful cross-section data can be obtained (Contractor's abstract)

1680

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

COLOR CENTERS IN MIXED CRYSTALS OF ALKALI HALIDES, by A. Smakula, N. C. Maynard, and A. Repucci. [1962] [7]p. incl. 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. 130: 113-119, Apr. 1, 1963.

Single crystals of KCl, RbCl, KBr and mixed crystals of KCl-RbCl, KCl-KBr, and RbCl-KBr of various compositions have been colored by 3-mev electrons with doses 10^4 to 10^6 rads at 20°, -80°, and -190°C. The influence of radiation dose, coloration temperature, and composition of mixed crystals on spectral position, half-width, and intensity of the V_1, K, F, F′, and M bands has been studied. At room temperature, K, F, and M bands were produced, and at highest coloration N bands; only F and K bands appear at -80°C. At -190°C coloration the V_1, K, F, and F′ bands appeared. In mixed crystals, the spectral position of all absorption bands deviates from the Mollwo relation (vd^n = const). The deviation in V_1, K, F, and M is toward lower, and in F′ toward higher energy. The half-width of all bands in mixed crystals is greater than in pure components except that of V_1 in the KCl-RbCl system, where it is smaller. The intensity of coloration in KCl-RbCl decreases with composition and reaches a minimum at molar ratio 1:1. In KCl-KBr and RbCl-KBr the intensity curves exhibit a relative maximum and a relative minimum. The behavior of the observed color-center bands is correlated to crystal structure and to the configuration of color centers.

1681

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DIFFRACTION OF ULTRASOUND IN ELASTICALLY ANISOTROPIC NaCl AND IN SOME OTHER MATERIALS, by E. P. Papadakis. [1962] [5]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-184110]) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 35: 490-494, Apr. 1963.

Ultrasonic diffraction in NaCl and KCl single crystals, as well as in steel, has been studied by the pulse-echo method from 8-45 mc sec with 1/2 in. disk transducers. The diffraction is of the Fresnel type, so that the curves of loss due to diffraction can be plotted with a normalized abscissa $S = z(a^2/\lambda)$, where z is the path length in the specimen, a the transducer radius, and λ the ultrasonic wavelength. In general, the loss curve is not monotonic in S. The shape of the curve is dependent upon the specimen material, the crystallographic direction of ultrasonic propagation, and the transducer plating configuration.

The position of the last local maximum in the loss curve is a function of the anisotropy of the specimen. In particular, its position in steel (isotropic case) agrees with the theoretical position for isotropic materials. (Contractor's abstract)

1682

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DIFFUSION-DAMPED DOMAIN-WALL MOTION, by J. F. Janak. Nov. 1962 [7]p. incl. diagrs. (Technical rept. no. 174) (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. 34: 3356-3362, Nov. 1963.

The Neel model of diffusion aftereffect has been used to analyze the motion of 90° and 180° domain walls when the aftereffect mechanism is present. Instability occurs in the response of the 180° wall to step and ramps of applied magnetic fields. For a step of field, the response of the wall is delayed from the time of application of the field by a time which decreases with increasing step height. For a ramp of field in a finite sample, instability occurs when a minimum ramp slope is exceeded. These instabilities furnish a basis for the explanation of the recently reported phenomenon of "dynamic squareness" of the hysteresic loop. (Contractor's abstract)

1683

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DYNAMIC SQUARENESS IN POLYCRYSTALLINE GARNETS, by B. W. Lovell and D. J. Epstein. Nov. 1962 [2]p. incl. illus. diagrs. (Technical rept. no. 173) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and [Signal Corps] under Nonr-184110) Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Published in Jour. Appl. Phys., v. 34: 1115-1116, Apr. 1963.

Certain samples of polycrystalline yttrium iron garnet and lutetium iron garnet have previously been found to acquire a square 60-cps hysteresis loop when cooled to 78 °K in a magnetic field. It is found that these are not normal square-loop materials, for at sufficiently slow excitation (ca 0.5 cps for yttrium iron garnet, one cycle per hour for lutetium iron garnet) they revert to normal, but strongly frequency-dependent loops. At 78 °K, for proper amplitude step excitation, the response of these cores is a delayed pulse. For lutetium iron garnet this delay can be several hundred u sec in duration. The behavior of these materials can be qualitatively explained by domain wall instability produced by a diffusion aftereffect mechanism. (Contractor's abstract)

1684

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DYNAMICS OF DIFFUSION-DAMPED DOMAIN WALL MOTION, by J. F. Janak. [1962] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Published in Jour. Appl. Phys., v. 34: 1119-1120, Apr. 1963.

The response of 90° and 180° (001)-plane domain walls acted upon by a damping pressure due to diffusion aftereffect, is investigated for steps and ramps of applied field. The resultant motion, using the Néel energy-level scheme for diffusants, is shown to be dynamically stable in the case of the 90° wall, in the sense that the incremental damping coefficient is never negative. Dynamic instability is shown to be possible for the 180° wall, and appears in the step response as a delay between the time of application of the field and the time of an observable response. The ramp response is unstable in a finite sample only when a minimum ramp slope has been exceeded. The ramp response is used to discuss the motion of the 180° wall under triangular-wave drive, and results similar to certain experimental observations are obtained. (Contractor's abstract)

1685

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

THE FORCE ON A MOVING DISLOCATION, by A. N. Stroh. Mar. 1962, 17p. incl. diagrs. (Technical rept. no. 169) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 274488 Unclassified

Also published in Phys. Rev., v. 126. 55-61, Oct. 1, 1962.

A Lagrangian formulation is used to discuss the nature of the force on a moving dislocation. Whether or not a Lorentz force appears depends on the definition of force adopted, but it is shown that this force can give rise to no physical effects; a definition which does not introduce it is therefore recommended. The force is given by the usual static expression ($F = \sigma b$) and is independent of the motion of the dislocation. (Contractor's abstract)

1686

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

LONGITUDINAL PUMPING OF MAGNETOELASTIC WAVES IN FERRIMAGNETIC ELLIPSOIDS, by F. R. Morgenthaler. [1962] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research,

Office of Naval Research, and Signal Corps under Nonr-184110) Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Published in Jour. Appl. Phys., v. 34: 1289-1290, Apr. 1963.

The instability threshold of parametrically excited magnetoelastic waves is derived, as a function of the dc magnetic field strength, for that region of field where the phonon and magnon spectra intersect. The case considered involves the longitudinal pumping (with an rf magnetic field of constant frequency 2ω), of a small ferrimagnetic single crystal having cubic symmetry. The crystal is ellipsoidal in shape and is magnetized along a [100] direction. The unstable magnetoelastic waves are a mixture of transverse phonons (polarized in the longitudinal direction) and magnons (spin waves) which propagate at (or very near) right angles to the dc field. If the 2 branches of the magnetoelastic wave spectrum are split by a frequency large compared to the phonon relaxation frequency, an approximate, and greatly simplified expression may be deduced from the general solution. It is found that the line shape of the phonon contribution to the threshold is asymmetric, and that the peak of the curve occurs for a smaller value of dc field than is generally believed. This shift in field is $\sim b^2 (2\Delta H_k)Q$ (where b is the magnetoelastic energy coefficient, $2\Delta H_k$ is the appropriate spin-wave linewidth, and Q is the appropriate phonon Q) and must be taken into account for an accurate determination of the exchange constant (particularly at the lower microwave frequencies). The peak of the phonon contribution to the threshold curve is independent of this shift and also of b; it is $\sim \lambda \omega^2 Q^{-1}$, where ω is the frequency of the magnetoelastic wave and λ is the exchange constant. The width of the peak at half-height is essentially independent of Q (except at very low frequencies) and is $\sim |b| M^2 \omega \lambda^{\frac{1}{2}}$, where M is the value of the saturation magnetization.

1687

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

THE MOLECULAR DESIGNING OF MATERIALS, by A. von Hippel. Jan. 1962, 34p. incl. illus. diagrs. refs. (Technical rept. no. 168) (Sponsored jointly by [Air Force Cambridge Research Labs.], [Air Force Office of Scientific Research], Office of Naval Research, and [Signal Corps] under Nonr-184110) AD 272120 Unclassified

Presented at 128th meeting of the Amer. Assoc. for the Advancement of Science, Denver, Colo., Dec. 26-30, 1961.

Studies on electrons, atoms and molecules, and their concerted action in gases, liquids and solids, has made molecular engineering possible. The theory of matter is discussed under the following subjects: (1) web of electron clouds; (2) atom structure; (3) elements and compounds; (4) molecules and crystals; (5) laws of molecular architecture; and (6) structure and properties.

1688

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

UNSTABLE GROWTH OF PHONONS AT HIGH MICROWAVE POWER LEVELS IN MAGNETICALLY ORDERED SINGLE CRYSTALS, by F. R. Morgenthaler. [1962] [2]p. incl. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1287-1288, Apr. 1963.

Conditions are given under which transverse and longitudinal microwave phonon standing waves present in a ferrimagnetic single crystal can be parametrically excited by the uniform precession of the magnetization. The instability thresholds for both first- and second-order processes are derived for crystals having cubic symmetry and are found to depend on higher-order magnetoelastic energy terms. The phonons need not be degenerate with any portion of the spin-wave band; in which case, the usual magnetoelastic coupling is absent. Competition from spin-wave processes is considered, and the conditions necessary for phonon domination are presented. The possibility of either maximizing or forbidding a particular phonon process is also discussed. (Contractor's abstract)

1689

[Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.]

STUDY OF EXTENSIVE AIR SHOWERS AT 5200 M ALTITUDE WITH SPECIAL RESPECT TO γ-RAY SHOWERS. Final rept. Oct. 1962, 1v. incl. illus. diagrs. tables, refs. (AFOSR-4780) (In cooperation with San Andres U., La Paz (Bolivia) and Tokyo U. (Japan)) (AF 49(638)922) AD 415424 Unclassified

The equipment, its construction and its installation on Mt. Chacaltaya are described. The main results of the study of extensive air showers at 5200 m altitude are discussed with respect to: (1) the search for showers generated by primary cosmic gamma rays of energy greater than 10^{14} ev; (2) the search for evidence of Z primaries; and (3) the character study of ultra high energy nuclear interactions. A study of the experimental arrangement and classification of showers and the results (recognition of separate groups of showers, distribution of arrival directions and conclusion) is presented.

1690

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

RESULTS ON GAMMA RAY ASTRONOMY FROM EXPLORER XI, by W. L. Kraushaar and G. Clark. [1962] [10]p. incl. diagrs. table. (AFOSR-64-0032) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)922, Atomic Energy Commission, National Aeronautics and Space Administration and Office of Naval Research) Unclassified

Also published in Proc. Fifth Interamer. Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 1: paper no. 16, Sept. 1962.

Explorer XI carried a gamma ray detector to make astronomical observations with high energy (> 50 mev) primary cosmic gamma rays. The results of this experiment are presented. The synchrotron tests showed that the instrument responded to x-rays with an aperture cone of about 17° half angle. The albedo effect observed during the tumble phase indicated that the telescope was selectively sensitive to x-rays in orbit. If the results obtained during the tumble phase are confirmed by subsequent measurements, a serious problem of explaining how the x-ray energy intensity can so greatly exceed the nonthermal radio energy intensity is indicated.

1691

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

PROPERTIES OF EXTENSIVE AIR SHOWERS AT 4200 M, by C. Clark, I. Escobar, and J. Hersil. [1962] [6]p. incl. diagrs. (AFOSR-64-0035) (AF 49(638)922) Unclassified

Also published in Proc. Fifth Interamer. Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 2: paper no. 36, Sept. 1962.

A large array of 11 scintillation detectors were used to observe several thousand extensive air showers with sizes between 10^6 and 10^9. A brief description of the results of the comprehensive analysis carried out on this data is presented.

1692

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EXTENSIVE AIR SHOWERS AT CHACALTAYA, 5200 METERS ABOVE SEA LEVEL, by G. Clark, I. Escobar and others. [1962] [5]p. (AFOSR-64-0036) (Also bound with its AFOSR-4780; AD 415424) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)922, Bolivian Government, and Japanese Ministry of Education) Unclassified

Also published in Proc. Fifth Interamer. Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 2: paper no. 37, Sept. 1962.

Construction of the Bolivian Air Shower Joint Experiment (BASJE) has been completed. The equipment consists of electron density detectors, scintillators, and an energy flow meter composed of lead glass Cerenkov detectors. A summary of the results of the first 6 months of operation is given. The results are concerned with the search for showers generated by primary cosmic gamma rays of energy greater than 10^{14} ev, the search for evidence of high Z primaries, and the study of the character of ultra high energy nuclear interactions.

1693

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PRIMARY GAMMA RAY OBSERVATIONS BY EXTENSIVE AIR SHOWERS, by G. Clark, I. Escobar and others. [1962] [16]p. incl. diagrs. (AFOSR-64-0037) (Also bound with its AFOSR-4780; AD 415424) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)922, Bolivian Government, and Japanese Ministry of Education) Unclassified

Also published in Proc. Fifth Interamer. Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 2. paper no. 43, Sept. 1962.

The preliminary analysis of data taken for the purpose of searching for showers generated by primary gamma rays is described. The criterion used in looking for such events is that showers produced by primary gamma rays must not contain appreciable numbers of mu-mesons and nucleus-active particles. Also included is a description of the equipment used.

1694

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

METHODS FOR OBSERVING EXTREMELY LARGE EXTENSIVE AIR SHOWERS, by K. Suga. [1962] [5]p. incl. diagr. (AFOSR-64-0038) (AF 49(638)922) Unclassified

Also published in Proc. Fifth Interamer Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 2: paper no. 49, Sept. 1962.

Air showers greater than 10^{19} particles have been observed and the size spectrum in this range shows no sign of an approaching cut-off. The highest energy of primary cosmic-ray particles which have been observed so far is of the order of 10^{19} ev. The plastic scintillators utilized enclose an area of $5km^2$. It would require waiting for them several decades to observe showers of over 10^{20} ev with such an array. Essentially different methods must be used to observe these large events. Methods based on the detection of scintillation light produced in the air by shower particles and based

on the reception of echo radio signals from the ionizated air column produced by the shower particles are discussed.

1695

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

YIELD AND ANGULAR DISTRIBUTION OF CERENKOV RADIATION FROM EXTENSIVE AIR SHOWERS, by H. Kasha and Y. Oren. [1962] [9]p. incl. diagrs. table. (AFOSR-64-0400) (AF 49(638)922) Unclassified

Also published in Proc. Fifth Interamer. Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 2: paper no. 45, Sept. 1962.

The relative yield of Cerenkov radiation from extensive air showers (EAS) and its angular distribution were measured as a function of the shower size in the range 4×10^4 to 2×10^6 particles. It was found that the larger showers are not as efficient in producing Cerenkov light signals as the smaller ones. The effect can be understood in light of the results on the angular distribution of Cerenkov radiation near the shower axis which showed more peaked forwards in larger showers. This result also leads to the conclusion that the angular distribution of electrons with energy > 21 mev near the axis of EAS is dependent on the shower size. (Contractor's abstract)

1696

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

PROCEEDINGS OF THE FIFTH INTERAMERICAN SEMINAR ON COSMIC RAYS, LA PAZ (BOLIVIA) (July 17-27, 1962), VOL. I. Sept. 1962, 1v. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)922, Bolivian National Academy of Sciences, La Paz U., Latin American Council of Cosmic Radiation, National Science Foundation, Pan American Union, and United Nations Educational Scientific and Cultural Organization Scientific Cooperation Office) Unclassified

Part of this volume is devoted to various introductory addresses and speeches. However, the majority of the work concerns the following aspects of outer space physics: (1) astronomy of the solar system; (2) radio astronomy; (3) primary energy spectrum; (4) directional asymmetry of primary cosmic rays; (5) high energy interactions; and (6) instrumentation.

1697

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

PROCEEDINGS OF THE FIFTH INTERAMERICAN SEMINAR ON COSMIC RAYS, LA PAZ (BOLIVIA) (July 17-27, 1962) VOL. II. Sept. 1962, 1v. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)922, Bolivian National Academy of Sciences, La Paz U., Latin American Council of Cosmic Radiation, National Science Foundation, Pan American Union, and United Nations Educational and Cultural Organization Scientific Cooperation Office) Unclassified

Various aspects of cosmic radiation are discussed including extensive air showers, temporal variations in cosmic radiation, origin of cosmic radiation, and high energy interactions.

1698

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

SEARCH FOR EXTENSIVE AIR SHOWERS INITIATED BY HIGH-ENERGY COSMIC γ-RAYS (Abstract), by G. W. Clark, I. Escobar and others. [1962] [1]p. (In cooperation with San Andres U., La Paz (Bolivia)) [AF 49(638)922] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 311, Apr. 23, 1962.

The Bolivian Air Shower Joint Experiment (BASJE) began operation in January with 45 detectors and a 60-in. multiplate cloud chamber at an altitude of 5200 m. The detailed structure of extensive air showers are being studied with the hope of detecting showers generated by high-energy primary cosmic γ-rays. Fast-timing and electron-density measurements give accurate determinations of the arrival directions, sizes, and core locations of showers at a rate of 300/hr for showers with more than 3×10^4 particles. Fifteen $4m^2$ scintillation detectoes shielded by 160 g/cm^2 of galena (PbS) measure the penetrating component, and 7 lead-glass Cerenkov detectors under the same shield measure the energy flow. A search for showers that have little or no penetrating component is being made with the idea that they may be produced by cosmic γ-rays. Results from the early period of operation are presented.

1699

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

SEARCH FOR PRIMARY COSMIC GAMMA RAYS WITH THE SATELLITE EXPLORER XI, by W. L. Kraushaar and G. W. Clark. [1961] [4]p. incl. illus. diagr. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)922], Atomic Energy Commission, National Aeronautics and Space Administration, and Office of Naval Research) Unclassified

Published in Phys. Rev. Ltrs., v. 8: 106-109, Feb. 1, 1962.

Preliminary results from gamma ray detectors launched in Explorer XI and their analysis are given.

1700

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ANNIHILATION OF ANTIBARYONS, by Y. Eisenberg. [1962] [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. Ltrs., v. 10: 60-62, Jan. 15, 1963.

The asymmetry of the "strange" mesonic cloud surrounding baryons and antibaryons can lead to the asymmetric c.m. angular distribution for $\bar{p}p \to k\ k+$ and similar processes. The existing experimental results seem to support this conjecture.

1701

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

ASYMPTOTIC CONES OF ACCEPTANCE AND THEIR USE IN THE STUDY OF THE DAILY VARIATION OF COSMIC RADIATION, by U. R. Rao, K. G. McCracken, and D. Venkatesan. [1962] [25]p. incl. diagrs. tables, refs. (In cooperation with Iowa State U., Iowa City) (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 Jour. Geophys. Research, v. 68: 345-369, Jan. 15, 1963.

The dependence of the counting rate of a cosmic ray detector on the asymptotic directions of approach of the primary cosmic radiation is discussed. By means of a simulation of the geomagnetic field that uses spherical harmonics up to the sixth degree, and an arbitrary anisotropy in the primary cosmic radiation, a method for calculating the time variations in the counting rate of a cosmic ray detector is developed. Resolving the arbitrary anisotropy as a Fourier series in longitude, the amplitude and phases of the diurnal (24-hourly) and semi-diurnal (12-hourly) components of the daily variation are calculated for a number of stations. No simple relationship is observed between the phases and the latitudes and longitudes, geographic or geomagnetic. Moreover, the theoretical calculations point out that a difference of more than 5 hr between the diurnal phases at 2 different places could arise purely from the known geomagnetic configuration. A study of the time-averaged diurnal component of the daily variation experimentally observed by 22 neutron monitors during the International Geophysical Year (1957-1958) reveals good agreement with the theoretical calculations and leads to the following conclusions: (1) The results are consistent with anisotropy that is independent of rigidity in the range 1-200 bv, the exponent of the power law which fits the data being 0.0 ± 0.05; (2) The anisotropy varies as the cosine of the asymptotic latitude and has a maximum in the direction 85° to the east of the earth-sun line; and (3) The maximum amplitude of the average anisotropy is 4×10^{-3} times the average cosmic ray flux.

1702

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ASYMPTOTIC FIELD OPERATORS IN QUANTUM FIELD THEORY, by S. S. Schweber and E. C. G. Sudarshan. [1962] [32]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], and National Science Foundation) Unclassified

Published in Ann. Phys., v. 19: 351-382, Sept. 1962.

It is the purpose of this paper to generalize in a systematic fashion the notion of asymptotic fields to encompass situations in which bound states occur. In Section I, the definition of in- and out-fields in nonrelativistic quantum mechanics is reviewed. In Section II, asymptotic operators are introduced within the nonrelativistic framework and their properties are investigated. Section III generalizes these definitions to encompass relativistic field theories. The last section summarizes the work of this paper and indicates certain new avenues opened by the present definitions.

1703

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE BETHE-SALPETER EQUATION IN NONRELATIVISTIC QUANTUM MECHANICS, by S. S. Schweber. [1962] [17]p. (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 Ann. Phys., v. 20: 61-77, Oct. 1962.

It is shown that in nonrelativistic quantum mechanics, the Bethe-Salpeter equation reduces to the Schrödinger equation determining the relative motion upon using the translational invariance of the theory. (Contractor's abstract)

1704

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

$Bi^{209}(d, p)Bi^{210}$ REACTION AT LOW BOMBARDING ENERGIES AND WITH HIGH RESOLUTION, by J. R. Erskine, W. W. Buechner, and H. A. Enge. [1962] [9]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. 128: 720-728, Oct. 15, 1962.

The $Bi^{209}(d, p)Bi^{210}$ reaction has been studied with a multiple-gap magnetic spectrograph and an 8-mev electrostatic accelerator. Forty energy levels were

observed up to an excitation energy of 3.2 mev. The ground-state Q value was measured to be 2.369 ± 0.010 mev. The angular distribution of each group was peaked at an observation angle of 180° because of the large Coulomb barrier and relatively low bombarding energy, and the width of the backward peak depends weakly on the ℓ value of the captured neutron. There is good agreement concerning the shape of the angular distribution between the experimental data and calculations using distorted-wave, deuteron-stripping theory. The ground-state group belongs to a cluster of 9 groups, one of which is probably 2 unresolved groups. These 9 groups probably correspond to levels in the Bi^{210} ground-state configuration ($h_{9/2}g_{9/2}$). The intensities of these groups appear to be proportional to the statistical factor (2J + 1). (Contractor's abstract)

1705

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

CHARACTERIZATION OF Ru^{107}, Ru^{108}, Rh^{107}, AND Rh^{108}, by W. R. Pierson, H. C. Griffin, and C. D. Coryell. [1962] [15]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research and Atomic Energy Commission under [AT(30-1)2098])
Unclassified

Published in Phys. Rev., v. 127: 1708-1722, Sept. 1, 1962.

The mass number of Rh^{107} (21.7 ± 0.4 min) has been confirmed by alpha bombardment of Ru^{104} at selected energies, by fast-neutron bombardment of Pd^{108}, and by chemical identification; and the mass number of Rh^{108} (16.8 ± 0.5 sec) has been established by the nature of its γ radiations. The mass numbers of the two precursors Ru^{107} (4.2 ± 0.3 min) and Ru^{108} (4.5 ± 0.2 min) have thereby also been established. The main radiations associated with these species are as follows: (energies in kev): Ru^{107} β groups of 2100 ± 300 and 3150 ± 300, γ rays of 195 (14%, coincident with the 2100 β), 370 (~ 6%, coincident with the 195 γ), 480 (weak, seen only in coincidence with the 195 γ), 860 (7%, coincident with the 195 γ), 930 (4%), 1030 (4%), and 1290 (4%); Ru^{108} β groups 1150 ± 100 and 1320 ± 100, a γ of 165 ± 3 (28%, coincident with the 1150 β); Rh^{107} β groups 840 ± 40, 940 ± 70, 1140 ± 50, and 1200 ± 50 kev, γ rays of 115 (0.5%), 235 (~ 3%, seen only in coincidence with the 390 γ), 307 (73%, coincident with the 1200 β), 365 (~ 2%, coincident with the 307 γ), 390 (11%, coincident with the 1140 and 840 β groups), 470 (1%), 570 (2%, coincident with the 940 β), and 675 (3%, coincident with the 840 β), and γ coincidence-sum lines at 680 (~ 3%), 880 (very weak), and 1140 (≤ 0.5%); Rh^{108} β of 4500 ± 600 kev, γ rays of 430 (43%), 510 (10%, partly coincident with the 430 γ), 620 (22%, coincident with the 430 γ), 1520 (5%), and 2000 (≤ 3%). No 940 γ from the Pd^{108} 940 level could be detected (< 3%), and less than one-third of the 510 γ rays follow β transitions to the 940 level. All γ rays above 115 in the 4 species are in fast coincidence with β rays. There are other γ rays associated with these species, especially for Ru^{107} and/or Rh^{108} above 1500. No evidence was found for isomers of Pd^{107}, Rh^{107}, PD^{108}, or Rh^{108} from decay of 21.7-min Rh^{107} or 16.8-sec Rh^{108}. No Rh^{107} or Rh^{108} isomers could be isolated. However a γ ray of 21 kev, presumed to be K x rays of rhodium, appears in the short-lived ruthenium spectrum, with an intensity 5 to 8% relative to Ru^{107}. The following decay paths are proposed: decay of Ru^{107} (Q^β = 3200) proceeding to Rh^{107} excited levels of 1290 (4%), 1030 (11%), 930 (4%), 675 or 1530 (< 5%), 565 (~ 6%), and 195 (0 to 5%), and to ground state (74%), with the reservation that it is likely that some of these levels should be referred to the supposed isomeric level rather than to the ground level; decay of Rh^{107} (Q^β = 1510) proceeding to Pd^{107} levels of 1140 (~ 0.2%), 675 (may be more than one level, 7%), 570 (2%), 470 (1%), 390 (8%), and 307 (71%), and to ground state (0 to 17%); decay of Ru^{108} (presumably 0+, Q^β = 1320) proceeding to Rh^{108} levels of 165 (0+ or 1+, 28%) and ground state (1+, 72%); decay of Rh^{108} (1+, Q^β = 4500) proceeding to Pd^{108} levels of 2000 or higher (≤ 3%), 1520 or higher (> 5%), 1050 (0+, 22%), 940 (2+, 0 to 5%), and 430 (2+, ~17%), and to ground state (0+, 51%). Interpretations of these schemes are presented. (Contractor's abstract)

1706

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

CLASSICAL DESCRIPTION OF DEUTERON STRIPPING IN A COULOMB FIELD, by R. H. Lemmer. [1962] [6]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 Nuclear Phys., v. 39: 680-685, Dec. 1962.

The Coulomb stripping of deuterons is discussed in a simple semiclassical approximation and a closed form for the proton angular distribution is obtained.

1707

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

COMMENTS ON CHEW'S BOOTSTRAP RELATIONSHIP, by F. E. Low. [1962] [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. Ltrs., v. 9: 277-279, Sept. 15, 1962.

G. F. Chew has previously shown the existence of a certain reciprocity between the nucleon and the (3,3) resonance. Chew's equations for the reduced width and P-wave amplitudes are extended to show that the validity

of the reciprocity is wider than he has claimed. The reciprocity is independent of the energies and coupling constants of the states, and is more a property of the form of the equations than of the particular solution found in nature. Therefore, the existence of an alternative interpretation of Chew's results is presented. Chew's theory is compared to a Lagrangian model, and their similarities and differences are discussed.

1708

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

A DATA HANDLING SYSTEM FOR A SCINTILLATION COUNTER HODOSCOPE (Abstract), by P. Gorenstein and L. S. Osborne. [1962] [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 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 9, Jan. 24, 1962.

A system is in operation at the M.I.T. Synchrotron Lab. for recording and storing data from an 80 element scintillation counter hodoscope. The use of such a multichannel detection system at a pulsed accelerator involves the problem of sorting and storing the information from many events which may occur during the short spill-out of the beam. The system to be described consists of a fast, 1-μ sec, reliable "buffer storage" of 8-eighteen-bit words which accumulate during the 800 μ sec burst of the synchrotron and a tape punch which prints out at a maximum speed of 100 lines/sec during the 0.15-sec off time of the accelerator. Provision is made for some limited data analysis as a criterion for accepting events. During an on time of 6 months, the laboratory had a transistor failure rate of about 6 out of 600. An important feature of this system is its utilization of commercially available engineered components, thus taking advantage of the great advances in reliability and speed that have been made in digital computer technology in recent years.

1709

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

DECAY OF Tl^{199} AND Au^{199}, by R. W. Bauer, L. Grodzins, and H. H. Wilson. [1964] [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. 128: 694-699, Oct. 15, 1962.

The decays of Tl^{199} to Hg^{199} and Au^{198} to Hg^{199} have been examined using γ-ray coincidence spectrometry and angular correlation techniques. The level order as well as level spins of Hg^{199} deduced from this study support the recent work of Jung and Svedberg. The branching ratios of the electron capture transitions from Tl^{199} to 6 levels in Hg^{199} have also been determined. Particular emphasis was placed on obtaining the empirical parameters of importance to the measurement of the magnetic moment of the 158-kev first excited state in Hg^{199} as well as to the interpretation of the state as one member of a doublet resulting from coupling the $1/2^-$ ground state with the 2^+ core excitation. This interpretation, due to de-Shalit, implies the interrelations of some of the magnetic moments and lifetimes of the states involved. This study supports such an interpretation. (Contractor's abstract)

1710

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

DIRECT AND COMPOUND NUCLEUS EFFECTS IN NUCLEAR PHOTODISINTEGRATION, by C. Shakin. [1962] [14]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. 22: 54-67, Apr. 1963.

A modified form of H. Feshbach's unified theory of nuclear reactions is used to construct the correct final state for the calculations of photodisintegration. The reaction theory used satisfies the requirements of the Pauli Principle. A correlation is made between resonance phenomena and shell model states whose energies are determined to lie in the continuum of the complete nuclear Hamiltonian. The calculated cross-sections include, in addition to the usual Breit-Wigner expression, another contribution which may be termed direct. It is important to note that the direct contribution to the cross section exhibits resonant behavior simultaneously with the Breit-Wigner expression. (Contractor's abstract)

1711

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

ENERGY LEVELS OF P^{29} FROM THE SCATTERING OF PROTONS BY Si^{28} (Abstract), by E. Kashy, M. W. Brenner, and A. M. Hoogenboom. [1962] [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. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 73, Jan. 24, 1962.

Energy levels of P^{29} have been observed as resonances in the differential elastic- and inelastic-scattering cross section for protons incident upon natural silicon (92.2% Si^{28}). Twenty-two resonances were observed in the

bombarding energy range from 4.8 to 7.0 mev, corresponding to levels in P^{29} from 7.4 to 9.5-mev excitation. By compering the differential elastic-scattering cross section at center-of-mass angles of 92.1, 54.7, and 125.3 deg with theoretical single-level dispersion theory calculations for the same angles, values of the orbital angular momentum of the incident protons were determined for most of the resonances. The analysis of the data and possible shell-model configurations of some of the levels will be discussed.

1712

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

ENERGY LEVELS OF Rh^{104} FROM THE Rh^{103} (d, p) Rh^{104} REACTION (Abstract), by A. G. Da Silva and W. W. Buechner. [1962] [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. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 83, Jan. 24, 1962.

The energy levels of Rh^{104} have been investigated by analyzing the reaction protons resulting from the bombardment of Rh^{103} with 7.0-mev deuterons using high-resolution, broad-range magnetic spectrographs. Proton groups corresponding to 33 levels below 1.5-mev excitation energy in Rh^{104} were observed. A Q value of 4.735 mev was obtained for the highest energy proton group. There is some evidence that this group corresponds not to the ground state of Rh^{104} but to an excited level at 0.051 mev. Angular distributions of protons to 5 of the low-lying levels were obtained. Theoretical angular distributions have been calculated, using the distorted-wave Born approximation method for states expected in this region. These do not closely resemble the angular distributions obtained experimentally. The angular distributions will be shown and possible level assignments will be discussed.

1713

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

ENERGY SPECTRA AND ANGULAR DISTRIBUTIONS OF PHOTOFISSION NEUTRONS (Abstract), by J. L. Matthews, W. Bertozzi and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, National Science Foundation, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 303-304, Apr. 23, 1962.

The energy spectra of neutrons emitted in photofission of even-mass nuclei are expected to depend on the angle at which the neutrons are detected relative to the photon beam, owing to the anisotropy of the fission fragments near threshold. Calculations of the spectra have been undertaken on the assumption that neutrons are emitted after fission and isotropically in the frame of reference of the moving fragments. The angular distribution of the fragments relative to the beam is of the form $(a + b \sin^2\Theta)$. Measurements of the spectra from U^{238} and Th^{232} at 79° and 159° relative to the beam direction are compared with these calculations.

1714

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

THE HIGH ENERGY BEHAVIOR OF SCATTERING AMPLITUDES IN PERTURBATION THEORY. I, by P. G. Federbush and M. T. Grisaru. [1962] [11]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 Ann. Phys., v. 22: 263-273, May 1963.

A procedure is described for extracting the dominant behavior at high energies of individual Feynman diagrams. This procedure is illustrated by the calculation of several examples, and is applied to the summation of several classes of diagrams in the high energy limit. Although all the examples dealt with concern spinless bosons, and nonderivative coupling, the inclusion of spin and more complicated couplings does not alter the basic method. (Contractor's abstract)

1715

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

HIGH ENERGY BEHAVIOR OF SCATTERING AMPLITUDES IN PERTURBATION THEORY. II, by P. G. Federbush and M. T. Grisaru. [1962] [10]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 Ann. Phys., v. 22: 299-308, May 1963.

The methods of previous papers are applied to problems involving particles with spin, and diagrams that require renormalization. Effects of the insertion of self-energy and vertex corrections are illustrated by examples. The class of diagrams describing electron-electron scattering by massive photon exchange, in the absence of photon-photon interactions and with neglect of exchange, is considered. It is argued that individually these diagrams are dominated at high energy by s ln s. Some general rules emerge from the calculations, but rigorous proofs are lacking. (Contractor's abstract)

1716

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

A HIGH INTENSITY NANOSECOND PULSED VAN DE GRAAFF ACCELERATOR, by L. E. Beghian and M. K. Salomaa. [1962] [7]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 Nuclear Instr. and Methods, v. 17: 181-187, Oct. 1962.

A description is given of a Van de Graaff generator modified for nanosec pulsing in the terminal. The beam is chopped by sweeping past a limiting aperture with an RF oscillator. A discussion is given for the choice of design parameters. Pulse widths as low as 2×10^{-9} sec have been obtained. Typical operating conditions are 3×10^{-9} sec pulse width, $1/40$ duty cycle, peak currents 0.8-1 mA, with an average current of 17 μA. Measured gamma ray and neutron time spectra are shown. (Contractor's abstract)

1717

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ISOTROPY OF COSMIC RADIATION, by J. Linsley, L. Scarsi and others. [1962] [2]p. incl. table. (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. 8: 286-287, Apr. 1, 1962.

Extensive shower data obtained in 1960-61, and having 3 times the statistical weight of data in 1959-60 upon which previous reports were based, were examined for possible anisotropy. It is concluded that the experimental evidence available to this date indicates an isotropic distribution in the directions of arrival of primary particles with energies of the order of 10^{18} ev.

1718

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

LIGHT PIPE FOR A LARGE-AREA SCINTILLATOR, by P. Gorenstein and D. Luckey. [1962] [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. 34: 196-197, Feb. 1963.

A light pipe consisting of 8 plastic strips is used to couple the scintillator and phototube. The unit is more efficient than conventional wedge units and is easily made. Practical details of manufacture are given.

1719

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

MAGNETIC MOMENTS OF THE FIRST EXCITED 2+ STATES IN Sm^{152}, Gd^{154}, AND Gd^{156}, by R. W. Bauer and M. Deutsch. [1962] [10]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. 128: 751-760, Oct. 15, 1962.

The gyromagnetic ratios g of the 122-kev state of Sm^{152}, of the 123-kev state of Gd^{154}, and of the 89-kev state of Gd^{156} have been measured to be 0.35 ± 0.03, and 0.367 ± 0.03, and 0.32 ± 0.03, respectively, by the precession of the angular correlation of γ-ray cascades proceeding through these states in an external magnetic field. The perturbations of the angular correlations for sources both in aqueous solution and in molten anhydrous chlorides have been studied. The attenuation in a transverse magnetic field was used to determine the hyperfine structure constant of the 89-kev state of Gd^{156} in the $^8S_{7/2}$ ground state of Gd^{3+} in aqueous solution as $a = 17 \pm 3$ mc/sec. The perturbations in molten Gd sources were found to be much weaker than in solution and to be unaffected by magnetic fields. (Contractor's abstract)

1720

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

MESONS AND THE STRUCTURE OF NUCLEONS. PART IV. THE NUCLEON-NUCLEON POTENTIAL, by G. Costa and B. T. Field. [1962] [18]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. 18: 47-64, Apr. 1962.

The atomic model, in which physical nucleons are described as compound systems of a nucleon core plus a single pion, has been used as the basis for a computation of the low-energy interaction between 2 physical nucleons. Advantage is taken of previous work for the specification of the interaction between the pion and the nucleon core in the different possible states of total angular momentum and isotropic spin. An initial simplification, where one of the atoms is replaced by an effective scattering center, is only moderately successful in reproducing the gross features of the observed nucleon-nucleon interaction. The full computation (approached in the spirit of the Heitler-London

approximation to the H-H interaction) improves on the qualitative fit, but it is impossible to reproduce simultaneously the asymptotic behavior of both the central and tensor terms in the nucleon-nucleon potential using a reasonable set of pion-core interactions. A significant result is the derivation, using the simplified model, of a nucleon-nucleon spin-orbit interaction whose range is shorter than that of the other terms in the potential. The computation provides a strong indication that the spin-orbit interaction may arise from the same features of the pion-nucleon interaction as give rise to the resonant pion-nucleon scattering in the state of T = J = 3/2. (Contractor's abstract)

1721

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

METHOD TO MEASURE THE LIFETIME OF THE Σ^0 HYPERON, by K. Huang. [1962] [15]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. 123: 2793-2807, Dec. 15, 1961.

A method, suggested by Wattenberg to measure the lifetime of the Σ^0 hyperon, is analyzed theoretically. The suggested method consists of measuring the distribution of angles between the Dalitz pairs emitted in the process $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$, in which the Σ^0 was previously produced in a nucleus. The distribution function contains a part that depends both on the charge Z of the nucleus and on the lifetime of Σ^0. This part comes from the interference between the Z-dependent part of the matrix element with the Z-independent part. This interference owes its existence to 2 facts: that the target nucleon is in a bound state, and that the Σ^0 has a finite mass width. The effects of nuclear structure can be eliminated from the problem. A family of curves for the distribution functions corresponding to various values of the lifetime is obtained through the use of Born approximation for the Coulomb wave functions of the Dalitz pair. If the lifetime is in the neighborhood of 5×10^{-20} sec, then measurements with an accuracy of 10% would determine the lifetime to within a factor of 10. (Contractor's abstract)

1722

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

MÖSSBAUER EFFECT IN HIGH MAGNETIC FIELDS (Abstract), by N. Blum and L. Grodzins. [1962] [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. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 39, Jan. 24, 1962.

The nuclear hyperfine spectrum of the 14.4 kev gamma ray from Fe^{57m} has been investigated as a function of external magnetic field for several different environmental materials. Experimental results are presented for soft iron, stainless steel, and copper environments in transverse and longitudinal fields up to 80 kgauss. Preliminary analysis indicates that the resultant internal field at the radioactive nucleus may be given by a linear relation of the form $H_{nuc} = H_{int} + H_{ext}(1 + c)$, where c depends only upon the environmental material and is negative.

1723

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

MULTIPLE-GAP MAGNETIC SPECTROGRAPH FOR CHARGED-PARTICLE STUDIES, by H. A. Enge and W. W. Buechner. [1962] [3]p. incl. diagrs. 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 Rev. Scient. Instr., v. 34: 155-162, Feb. 1963.

A spectrograph has been designed that simultaneously records broad-range, charged-particle spectra at 24 different reaction angles, 7.5° apart, from 0 to 172.5°. At each angle, the spectrograph records a spectrum with a total energy range of about 2.3:1 and with a resolving power exceeding $R = E/\Delta E = 1000$, where ΔE is the full width at half-maximum of a peak. The recorders are seventy-two 2 x 10 in. nuclear-track plates, which are developed and scanned under a microscope after the exposures. When half-millimeter strips across the nuclear-track plates are scanned, the information contained on the nuclear-track plates after 1 exposure corresponds to about 36,000 data points. A typical exposure time with about a 0.5-μA beam is of the order of 2 to 3h.

1724

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE NEUTRON STRENGTH FUNCTION AND THE SHELL MODEL, by B. Block and H. Feshbach. [1962] [24]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. 23: 47-70, July 1963.

The projection operator-equivalent potential method is employed for the study of neutron widths and strength function. Assuming that the residual potential, V_R, consists of a sum of 2 particle potentials it can be shown with the aid of another plausible assumption that the width can be written as a product of 2 factors. One

of these is the square of the matrix element of V_R between the open channel wave function and a shell model 2 particle one-hole state. The second factor, giving the probability that the compound nucleus wave function contains the 2 particle-one hole state, decreases as the difference between the energy of the compound nucleus and the energy of the 2 particle-one hole state increases. The results are generalized to include the case where the energies of several 2 particle-one hole states fall close to each other. It is found that the giant resonance for the widths will now have a substructure which should be observable. The strength function is found to depend upon the average of the transition probabilities to the 2 particle-one hole states, the number of these states, and Δ. The number is sharply limited by the requirements that angular momentum and parity be conserved in the transition and that energy be conserved to within an error equal to Δ. If the residual potential is expanded in multipoles, keeping terms up to and including the quadripole, it is found that for the most part in the region $40 \leq A \leq 64$ the only possible transitions involve the monopole; between A = 68 and 85, both dipole and quadripole terms are effective as well, while between 85 and 130 only the quadripole term can induce transitions. This behavior enables one to obtain a fit to the data by means of 3 parameters: the average matrix elements squared for the monopole, dipole, and quadripole parts of the residual potential. (Contractor's abstract, modified)

1725

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

NUCLEAR ENERGY LEVELS IN P^{29}, by M. W. Brenner, A. M. Hoogenboom, and E. Kashy. [1962] [3]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. 127: 947-949, Aug. 1, 1962.

Excited levels in P^{29} have been observed as resonances in the differential elastic and inelastic scattering cross sections for protons incident upon natural silicon (92.2% Si^{28}) at proton energies from 4.8 to 7.0 mev. Resonances corresponding to 23 levels in P^{29} from 7.4- to 9.5-mev excitation were observed. The orbital angular momenta of the incident protons were determined for most of the resonances, using single-level dispersion theory. (Contractor's abstract)

1726

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

NUCLEAR EXCITATION FUNCTIONS AND THICK-TARGET YIELDS F^{19}, Na^{23}, As^{75} (d, t), AND Na^{23}, As^{75} (d, p), by L. H. Bowen and J. W. Irvine, Jr. [1962] [6]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]; General Electric Co., and National Science Foundation) Unclassified

Published in Phys. Rev., v. 127: 1698-1703, Sept. 1, 1962.

Excitation functions and thick-target yields have been determined for the (d, p) and (d, t) reactions which occur when sodium fluoride and arsenic targets are bombarded with deuterons of $\leq$ 15 mev. The yields of F^{18}, Na^{24}, and Na^{22} from sodium fluoride, and As^{76} and As^{74} from arsenic targets were measured with a calibrated scintillation counter after appropriate chemical treatment. The range-energy relationship for deuterons in sodium fluoride was determined experimentally from 15.2 mev to 5.3 mev. Absolute cross sections were determined at 15.2 mev for the following reactions: $Na^{23}(d,p)Na^{24}$ (125.7 ± 2.5 mb), $Na^{23}(d,t)Na^{22}$ (12.2 ± 2.0 mb), $F^{19}(d,t)F^{18}$ (29.0 ± 2.2 mb), $As^{75}(d,p)As^{76}$ (140.3 ± 6.6 mb), and $As^{75}(d,t)As^{74}$ (16.5 ± 1.2 mb). The results are shown to be in qualitative agreement with available information on the relative contributions of compound nucleus formation and direct interaction. (Contractor's abstract)

1727

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

NUCLEAR EXCITATION FUNCTIONS AND THICK-TARGET YIELDS: Zn + d AND $Ar^{40}(d,\alpha)$, by D. C. Williams and J. W. Irvine, Jr. [1962] [7]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. 130: 265-271, Apr. 1, 1963.

Radiochemical techniques have been used to determine partial or complete excitation functions to 15 mev for the reactions $Ar^{40}(d,\alpha)Cl^{38}$, $Zn^{66}(d,\alpha)Cu^{64}$, $Zn^{64}(d,\alpha n)Cu^{61}$, $Zn^{67}(d,\alpha n)Cu^{64}$, $Zn^{64}(d,2p)Cu^{64}$, and $Zn^{67}(d,2p)Cu^{67}$. The results have been compared with the predictions of the statistical model of nuclear reaction. Most features of the (d,α) and $(d,\alpha n)$ excitation functions measured are consistent with the predictions of the model. The $Zn^{67}(d,\alpha n)Cu^{67}$ reaction appears to take place essentially by a direct process, while the $Zn^{64}(d,2p)Cu^{64}$ reaction, which has a much higher cross section, agrees with the model. Support is found for a rather large value of the nuclear radius parameter, $r_0 = 1.7F$. Excitation functions are presented for the reactions $Zn^{64}(d,p)Zn^{65}$ + $Zn^{64}(d,n)Ga^{65}(\beta^+)Zn^{65}$, $Zn^{66}(d,n)Ga^{67}$, and $Zn^{66}(d,2n)Ga^{66}$. Thick-target yields from deuteron bombardment of metallic zinc are given for Cu^{61}, Cu^{64}, Cu^{67}, Zn^{65}, Ga^{66}, and Ga^{67}.

1728

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

NUCLEAR EXCITATION FUNCTIONS: Ar^{40}, Zn^{68} (d, He^3), by D. C. Williams and J. W. Irvine, Jr. [1962] [6]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. 130: 259-264, Apr. 1, 1963.

The (d, He^3) reaction has been studied by radiochemical techniques. Absolute excitation functions have been determined to 15 mev for the reactions Ar^{40}(d, He^3)Cl^{39} and Zn^{68}(d, He^3)Cu^{67}. The Ar^{40}(d, He^3)Cl^{39} cross section is 0.37 ± 0.07 mb at 14.8 mev and the Zn^{68}(d, He^3)Cu^{67} cross section is 0.54 ± 0.08 mb at 15.4 mev. These cross sections are shown to be more than an order of magnitude greater than predicted by the statistical model of nuclear reactions. The energy dependence of the cross section appears to be governed by the Coulomb barrier felt by the outgoing He^3 particle, at least when the He^3 energy is less than the classical barrier height. The shape of the observed excitation functions may be reproduced moderately accurately by a very simple proton pickup model.

1729

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ON FEYNMAN QUANTIZATION, by S. S. Schweber. [1962] [12]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 Jour. Math. Phys., v. 3: 831-842, Sept.-Oct. 1962.

The observation by Klauder that in the space of the $a = (1/\sqrt{2})(p + iq)$ variables, the Feynman integral can be defined in terms of a Gaussian measure, forms the basis of a presentation of the Feynman formulation of nonrelativistic quantum mechanics. The extension of this formulation to the case of a Bose field is sketched. (Contractor's abstract)

1730

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ON MODEL CALCULATIONS OF NEUTRON WIDTHS AND STRENGTH FUNCTIONS, by C. Shakin. [1962] [33]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. 22: 373-405, June 1963.

A procedure for calculating the neutron strength function as advanced by B. Block and H. Feshbach is considered. Methods are developed which relate the calculation of the strength function to the usual concepts of the shell model and nuclear optical model. Specific consideration is given to the isotopes of lead and tin and the agreement with experiment is good. Further, it is also shown that the neutron widths calculated for very simple excitations can be quite small for heavy nuclei due to cancellations which appear in a certain overlap integral. This result implies that the observation of a resonance of very small width does not necessarily imply the formation of a compound state of great complexity. The simple excitations considered are a reasonable approximation to the virtual states of a compound nucleus such as Pb^{209}, and in this case, the calculated widths agree in order of magnitude with the widths found experimentally. (Contractor's abstract)

1731

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

Pb^{208}(d, p)Pb^{209} REACTION AT A BOMBARDING ENERGY OF 7.5 MEV (Abstract), by J. R. Erskine and W. W. Buechner. [1962] [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. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 360, Apr. 23, 1962.

The Pb^{208}(d, p)Pb^{209} reaction has been studied at a bombarding energy of 7.5 mev with a multiple-gap magnetic spectrograph. The ground-state Q value was measured to be 1.705 ± 0.915 mev. Five excited states were observed at excitation energies of 0.774, 1.563, 2.015, 2.483, and 2.527 mev. The observed angular distributions all peak at 180° observation angle. The shapes of these angular distributions agree reasonably well with calculations made using distorted-wave stripping theory. These calculations, however, considerably underestimate the absolute cross section, presumably because of the neglect of deuteron polarization. The differential cross sections measured at 172.5° are, starting with the ground state: 0.33, 0.02, 2.84, 2.59, 0.43, and 2.52 mb sr. A comparison is presented between the data from the Pb^{208}(d, p)Pb^{209} reaction and similar data from the Bi^{209}(d, p)Bi^{210} reaction with regard to the number of levels, their positions, and yields. This comparison suggests that the observed Pb^{209} states are the following single-particle neutron states, starting with the ground state: $g_{9/2}$, $i_{11/2}$, $d_{5/2}$, $s_{1/2}$, $g_{7/2}$, and $d_{3/2}$.

1732

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

PHOTOGRAPHS OF CERENKOV LIGHT FROM E. A. S. AND THEIR INTERPRETATION, by D. A. Hill, J. Overbeck and others. [1962] [13]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 Proc. Fifth Interamer. Seminar on Cosmic Rays La Paz (Bolivia) (July 17-27, 1962), v. 2: paper no. 46, Sept. 1962.

Large mirrors with photomultipliers in coincidence are capable of detecting showers of about 10^{12} ev. Their angular resolution is limited by distortion of the incident light from the true direction, and this limitation will be comparable in magnitude at all altitudes. Intensifier systems are capable of angular resolution approaching 0.1°, and can be used to cover a large field of view, but their energy threshold is limited by the necessity for integrating background light over a time sufficient to switch on the system. Larger mirrors would reduce the energy threshold only slowly, since the ratio background pulse is independent of mirror area. The energy threshold is expected to be inversely proportioned to the diam of the mirror, since the fluctuations in background which limit photography are proportional roughly to the mirror area $^{0.5}$

1733

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

POLARIZATION OF NEUTRONS FROM THE PHOTODISINTEGRATION OF DEUTERIUM, by W. Bertozzi, P. T. Demos and others. [1962] [3]p. incl. 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 Phys. Rev. Ltrs., v. 10: 106-108, Feb. 1, 1963.

Existing treatments of the photodisintegration of the deuteron neglect mesonic effects and the experiment described in this paper was carried out to examine these mesonic effects. It is pointed out that at 90° to the photon beam, the polarization of the nucleons is due largely to the E1 and M1 interference and to a good approximation this determines the ratio of these E1 and M1 amplitudes. Details of the experimental apparatus and technique are provided and results given for 3 ranges of γ-ray energy from 12-15 mev, 15-20 mev and 20-30 mev. The results do not offer any evidence of a large correction due to mesonic effects within the uncertainty of the experiment. Computer calculations at present in progress will subsequently reduce still further the experimental uncertainty.

1734

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PROTON GROUPS FROM THE $S^{33}(d, p)S^{34}$ REACTION, by M. W. Brenner. [1962] [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. 129: 765-768, Jan. 15, 1963.

Natural and 25% enriched sulfur targets sandwiched between 2 silver layers were bombarded with deuterons accelerated in the MIT-ONR electrostatic accelerator to an energy of 6.0 mev. Proton groups from the (d, p) reactions were observed at angles 90, 50, and 20 degrees to the deuteron beam with a broad-range magnetic spectrograph. Twenty-three proton groups corresponding to levels in S^{34} were observed. The ground-state Q value of the $S^{33}(d, p)S^{34}$ reaction was measured as 9.193 ± 0.010 mev.

1735

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

QUADRUPOLE MOMENTS OF THE FIRST 2+ STATES OF W^{182}, W^{184}, AND W^{186} (Abstract), by E. A. Phillips and L. Grodzins. [1962] [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. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 359-360, Apr. 23, 1962.

The Mössbauer effect is being used to measure the ratio of the quadrupole moments of the first 2+ levels in the even-even tungsten isotopes. The source, in an environment with cubic symmetry, is doppler shifted at 4°K with respect to an absorber yielding a measurable quadrupole splitting. A search for a tungsten compound exhibiting a completely resolved hyperfine spectrum has so far been unsuccessful, though several compounds have sufficiently large electric field asymmetries for the quadrupole interaction to be measured to 5%. Preliminary results for the separation of the $m = 2$ and $m = 0$ lines for the 100 kev state of W^{182} in WS_2, $CaWO_4$, WO_3, and WC are -0.55, -0.4, -0.4, and +0.35 cm sec. respectively. A positive number means that the $|m| = 2$ line has higher energy. These results can, of course, be used with Coulomb excitation measurements of the transition quadrupole moment for the 100-kev transition to estimate an electric field gradient at the nucleus of about 5×10^{17} volts cm^2. Preliminary results on the 2+,

111-kev state in W^{184} indicate that its quadrupole moment differs from that of the 2+, 100-kev state in W^{182} by less than 25%, in agreement with Coulomb-excitation data.

1736

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

RADIATION GAUGE ELECTRODYNAMICS. I. THE TWO-POINT FUNCTION, by C. R. Hagen. [1962] [8]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. 130: 813-820, Apr. 15, 1963.

The Lehmann representations of the spin zero and spin one-half Green's functions are studied with particular emphasis upon infrared effects. By means of a Bloch-Nordsieck type model the infrared parts of these functions are calculated and the analytic properties of the solution examined. A double integral representation of the 2-point function is proposed and a possible application suggested.

1737

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

RADIATION-GAUGE ELECTRODYNAMICS. II. THE ASYMPTOTIC CONDITION, by C. R. Hagen. [1962] [12]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 Nuovo Cimento, Series X, v. 28: 970-981, June 1, 1963.

The use of the asymptotic condition in electrodynamics is criticized and an alternative approach suggested which utilizes specific properties of the radiation-gauge Green's functions. This technique is based upon the introduction of a nonlocal field operator which has the property of asymptotically creating physical electrons without the usual emission of soft quanta. It is shown by means of an example how a cross-section may be calculated without either the appearance of spurious infrared divergences or the improper imposition of an asymptotic condition. (Contractor's abstract)

1738

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

RADIATION OF LOW ENERGY QUANTA IN NUCLEAR REACTIONS by H. Feshbach, D. R. Yennie and others. [1962] [22]p. incl. diagr. 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. 37: 150-171, Aug. 1962.

The production of radiation concomitant with the elastic scattering of nucleons by nuclei is considered. It is shown that the first term of a series expansion of the differential radiation cross-section in the energy of the radiated quantum may be expressed in terms of the elastic scattering amplitudes at the incident and final energies. This result is valid even when there are resonances in the scattering whose widths are a small fraction of the energy loss. The interference between these 2 amplitudes permits the determination of the shape elastic amplitude, and therefore the cross section for compound elastic scattering as well as the correlation distance W defined as the energy separation over which there is a substantial correlation in the fluctuations in the elastic scattering amplitude; its inverse measures the time delay in the reaction. When a resonance has a width of the order of the energy loss, the interference can be employed to evaluate the change of phase of the elastic scattering amplitude across the resonance and may therefore serve as an indicator of whether or not a fluctuation in the elastic cross-section is a resonance. These results when applied to reactions lead to a method for the measurement of the relative amount of direct and compound nuclear processes and to a direct test of the random phase approximation of the statistical hypothesis in nuclear reactions. A derivation of the principal result valid for relativistic particles is also given. (Contractor's abstract)

1739

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

A SEARCH FOR A FREQUENCY SHIFT OF 14.4 kev PHOTONS ON TRAVERSING RADIATION FIELDS, by R. Weiss and L. Grodzins. [1962] [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. Ltrs., v. 1: 342-344, July 15, 1962.

Two experiments designed to test two hypothetical photon-photon mechanisms which were proposed to account for the frequency (red) shift of galactic light: a shift which is generally attributed to the Doppler effect from an expanding universe are reported. Both experiments gave negative results and evidence against these hypotheses. The experiments were done using the Mössbauer effect with 14.4 kev photons which were made to pass through a one-metre long X band cylindrical cavity, and tube kept at a temperature of 1300°K, each of which simulated the black body radiation field of outer space.

1740

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

A SEARCH FOR A ω^o MESON IN THE MASS RANGE OF 300-500 MEV (Abstract), by D. Luckey, D. Garelick and others. [1962] [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. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 40, Jan. 24, 1962.

The existence of a heavy neutral meson is suggested by electron scattering experiments and has been sought by many experimenters. We have searched for a ω^o meson assuming that they are coherently produced from complex nuclei with a cross section proportional to A^2 in the forward direction (as are π^o's), the decay mode is $\gamma + \pi^o$, and the spin is 1. Single and double π^o photoproduction are suppressed by conservation of angular momentum. The experiment consisted of 3 total-absorption gamma-ray counters located to optimize the detection efficiency of ω^o's of mass 300-500 mev. Targets of carbon and titanium were used in the bremsstrahlung beam of the Cornell Synchrotron. The pulse heights and arrival times of events were recorded on film. Analysis sets a maximum limit of 5×10^{-33} cm^2/sr for the production from hydrogen with the above assumptions. Various backgrounds will be discussed.

1741

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE SEPARATION OF WORLD-WIDE CHANGES OF ISOTROPIC INTENSITY FROM THE DAILY VARIATION OF COSMIC RAYS, by U. R. Rao. [1962] [4]p. incl. diagr. 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 Jour. Geophys. Research, v. 68: 2049-2052, Apr. 1, 1963.

It is shown that the conditions required for the validity of the method of Sekido et al. make its application impossible at the moment, due to the unavailability of suitable stations.

1742

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

SINGLE-PARTICLE LEVELS OF Ca^{49} (Abstract), by E. Kashy, A. Sperduto and others. [1962] [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. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 315, Apr. 23, 1962.

The energy levels of Ca^{49} from 0- to 5-mev excitation energy have been investigated through the reaction $Ca^{48}(d,p)Ca^{49}$ using 7.0-mev deuterons. The target consisted of $CaCO_3$ enriched to 84.3% Ca^{48} and evaporated onto a thin gold foil. The angular distributions and energy spectrum of the reaction protons were measured using the MIT single- and multiple-gap spectrographs, with the angular-distribution data obtained from 7.5 to 172.5 deg in 7.5-deg intervals. A preliminary analysis of the proton groups, corresponding to levels at 0- and 2.026-mev excitation in Ca^{49}, indicates that these levels correspond to the $2p_{3/2}$ and $2p_{1/2}$ single-particle levels, in agreement with previous work. The analysis of the data and shell-model configuration of the remaining observed levels are discussed.

1743

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

SOME CONSEQUENCES OF NONUNIFORMITY OF SOLAR WIND VELOCITY, by V. Sarabhai. [1962] [3]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commision, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Jour. Geophys. Research, v. 68: 1555-1557, Mar. 1, 1963.

Conditions have been examined in interplanetary space along the solar equatorial plane that are likely to arise when the radial velocity of the solar windis a function of solar longitude. Some broad consequences of the growth and decay of regions of activity and enhanced wind velocity as a function of time have been considered. It has been shown that the resulting 2-dimensional model has attractive features relevant to the interpretation of several observed cosmic-ray variations.

1744

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

SOME EXPERIMENTAL ATTEMPTS TO DETECT COSMIC GAMMA RAYS, by W. L. Kraushaar and G. W. Clark. [1961] [5]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]; and National Aeronautics and Space Administration) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-5, 1961.

Published in Jour. Phys. Soc Japan, v. 17, Suppl. A-III: 1-15, Jan. 1962.

A satellite experiment designed to detect γ rays of energy 50 mev and over such as would arise from the decay of π^0 mesons is described. During about 23 hr of useful observing time, 127 events occurred which could be γ rays. Analysis of arrival direction data, possible sources of background, and the γ-ray source strength are discussed.

1745

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

STRIPPING ANALYSIS OF THE (d, p) ANGULAR DISTRIBUTIONS FROM THE $Cl^{35}(d,p)Cl^{36}$ AND THE $Cl^{37}(d,p)Cl^{38}$ REACTIONS. by A. M. Hoogenboom, E. Kashy, and W. W. Buechner. [1962] [10]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. 128: 305-314, Oct. 1, 1962.

The analysis of the angular distribution of the protons from the $Cl^{35,37}(d,p)Cl^{36,38}$ reactions revealed 46 levels in Cl^{36} and 4 levels in Cl^{38}, previously unreported and the l_n values and absolute differential cross sections for 30 groups to levels in Cl^{36} and for 7 groups to levels in Cl^{38}. The discussion, which is given in terms of the shell model, resulted in the following spin assignments: The 0.789-mev state in Cl^{36} has $J^\pi = 1^+$, and the 1.163-mev state has probably $J^\pi = 1^+$. The spins of the levels at 0.671, 0.761, and 1.309 mev in Cl^{38} are 5^-, 3^-, and 4^-, respectively. The observed values of the single-particle reduced width θ_0^2 for the different subshells agree quite well with the values given by Macfarlane and French for other nuclei. (Contractor's abstract)

1746

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

STRIPPING ANALYSIS OF THE $Fe^{56}(d,p)Fe^{57}$ REACTION (Abstract), by F. Alba, A. Sperduto and others. [1962] [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. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 315, Apr. 23, 1962

The MIT-ONR Van de Graaff accelerator and the multiple-gap broad-range spectrograph were used to study angular distributions of protons emitted from a thin target of Fe^{56}. Incident deuterons with energy of 7.5 mev were used, and the spectrum of protons observed corresponds to a range in excitation energy in Fe^{57} from the ground-state transition to about 6.5 mev. Data were obtained at 7.5-deg intervals from 7.5 to 172 deg. Preliminary analysis of 11 proton groups up to 1.73-mev excitation show typical forward-stripping patterns for 8 of the levels. The orbital angular momenta of the captured neutron l_n assigned are as follows:

Ex	0	0.014	0.137	0.367	1.256	1.359	1.630	1.728
l_n	1	1	3	1	1	1	1	1

The groups corresponding to levels in Fe^{57} at 0.708, 1.010, and 1.199 mev show no pronounced peaking. Results for levels above 1.73 mev are presented.

1747

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

STUDY OF THE K^+ DECAY, by A. M. Boyarski, E. C. Loh and others. [1962] [5]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. 128: 2398-2402, Dec. 1, 1962.

Some properties of the various decay modes of K^+ mesons have been studied with hodoscope scintillation counters. One hundred twenty two $K_{\mu 3}$ events were identified in the high-energy end of the muon energy spectrum from 115 ± 3 mev to 134 mev which yielded $(0.42 \pm 0.10)\%$ as the relative branching ratio. The result, together with the K_{e3} branching ratio and the low-energy end of the $K_{\mu 3}$ muon energy spectrum, is found to satisfy a constant form factor V-A interaction. The muon longitudinal polarization for the $K_{\mu 3}$ events was found to be $-0.8^{-0.2}_{-0.8}$ which is 2 standard deviations from the calculated value -0.81 using the constant form factors which best fit the spectrum. A lifetime analysis of the decay modes gave $\tau(K_{\mu 3}) = (1.06 \pm 0.16) \times 10^{-8}$ sec, $\tau(K_{\mu 2}) = (1.197 \pm 0.032) \times 10^{-8}$ sec, and $\tau(K_{e2}) = (1.259 \pm 0.017) \times 10^{-8}$ sec which are consistent with a single total lifetime, as expected. The total lifetime was found to be $\tau(K^+) = (1.231 \pm 0.011) \times 10^{-8}$ sec in agreement with previous values. The relative $K_{\mu 2}$ K_{e2} branching ratio was measured as 2.98 ± 0.25. A search for the occurrence of an intermediate-mass lepton in the decay $K \to \chi + \nu$ established 3×10^{-4} as the upper limit for the branching ratio with $m_e < m_\chi < 75$ mev. (Contractor's abstract)

1748

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

A UNIFIED THEORY OF NUCLEAR REACTIONS. II, by H. Feshbach. [1962] [27]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. 19: 287-313, Aug. 1962.

The effective Hamiltonian method for nuclear reactions described in an earlier paper (A Unified Theory of Nuclear Reactions. I.) is generalized to include all possible reaction types, as well as the effects arising from the identity of particles. The principal device employed is the projection operator which selects the open channel components of the wave function. It is found that the formal structure of part I providing a unified description for direct and compound nuclear reactions including the coupled equation description for direct reactions remains valid in this wider context. A Kapur-Peierls expansion may also be obtained. The concept of channel radii is not needed nor is any decomposition of the wave function for the system into angular momentum eigenstates required, so that the expressions for transition amplitudes and widths are invariant with respect to the angular momentum coupling scheme. Since the open channels can only be defined in an asymptotic sense, the corresponding projection operators are not unique. As a consequence, the projection operator method has a flexibility which in the first place is consonant with the wide range of phenomena which can occur in nuclear reactions and in the second place can effectively exploit an intuitive understanding of the phenomena. Examples of projection operators are obtained including one which leads to the Wigner-Eisenbud formalism, another which is appropriate for the stripping reaction, and, finally, one which takes the Pauli exclusion principle into account. Note that explicit representations of the projection operators are not required for the development of general formal results but are necessary if, eventually, quantitative calculations are made. (Contractor's abstract)

1749

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

VIOLATION OF ISOTOPIC SPIN CONSERVATION IN THE DECAY OF EXCITED MESONIC STATES, by B. T. Feld. [1962] [3]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 Phys. Rev. Ltrs., v. 7: 181-184, Feb. 15, 1962.

The decay into 4 pions of a pseudoscalar, isoscalar meson (0^{-+}) was alleged to be forbidden by parity conservation. Reference is made to the classic papers on the α-particle model of O^{16}. It was previously revealed that some 0^{-} configurations of 4 spin-zero bosons do exist, although the large values required for the internal vibrational and rotational quantum numbers would inhibit very strongly the decay of a 0^{-+} meson into 4 pions.

1750

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

CURRENT CARRYING CAPACITY OF SUPERCONDUCTING Nb-Zr SOLENOIDS, by D. B. Montgomery. July 1962, 17p. incl. diagrs. tables, refs. (AFOSR-3015) (AF 19(604)7344) AD 282158 Unclassified

Also published in Appl. Phys. Ltrs., v. 1: 41-43, Oct. 1, 1962.

A mechanism of induced persistent currents is offered to explain the low current carrying capacity of Nb-Zr solenoids. The persistent currents are induced as the magnet is energized and are of sufficient magnitude to saturate the superconducting filaments. The magnitude of the induced currents can be estimated from a measurement of the residual field in the solenoid. The current carrying capacity of Nb-Zr solenoids is shown to be a particular function of field, inside diameter, and geometry. The most important conclusion drawn is that to generate fields in large bore magnets will require more wire than would be predicted from considerations neglecting the induced currents. (Contractor's abstract)

1751

Massachusetts Inst. of Tech. [National Magnet Lab.] Cambridge.

STRONG MAGNETS, by F. Bitter. [1962] [7]p. incl. illus. diagrs. (AFOSR-3564) (AF 19(604)7344) Unclassified

Also published in Internat'l. Sci. and Tech., No. 4: 58-64, Apr. 1962.

High-field magnets are expanded, particularly in the light of the discovery of superconductors that can carry currents at high densities in the presence of high fields with no power requirement at all, as opposed to the megawatts required for water cooled magnets. Problems of magnet design are discussed and the advantages and difficulties of the major approaches to the production of high fields are compared. Several uses of high-field magnets are presented.

1752

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HIGH MAGNETIC FIELDS AND HIGH FREQUENCIES, by B. Lax. [1962] [1]p. (AFOSR-3565) (AF 19(604)-7344) Unclassified

Also published in Microwave Jour., v. 5: 13, Feb. 1962.

The possibility of large magnetic fields in vacuum electronic devices is discussed briefly. Several suggestions for the design and development of electronic devices are given.

1753

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

OSCILLATORY INTERBAND FARADAY ROTATION AND VOIGT EFFECT IN SEMICONDUCTORS, by Y. Nishina, J. Kolodziejczak, and B. Lax. [1962] [3]p. incl. diagrs. (AFOSR-3654) (Sponsored jointly by Air Force Office of Scientific Research under AF 19(604)-7344, Office of Naval Research, and Signal Corps) Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 55-57, July 15, 1962.

Some results for the interband Faraday rotation in Ge are presented. It is shown that some of the difficulties encountered in the use of the results for Faraday rotations are avoided if these are combined with measurements of the interband Voigt effect.

1754

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

A HIGH PERFORMANCE D.C. MAGNET UTILIZING AXIAL COOLED DISKS, by H. Brechna and D. B. Montgomery. Sept. 1962 [66]p. incl. illus. diagrs. tables, refs. (Rept. no. NML-62-1) (AFOSR-4226) (AF 19(604)7344) AD 290778 Unclassified

A 1-in. bore, iron-clad, water-cooled solenoid recently built utilized a new hexagonal cooling pattern and a number of other new design features. It produced a field of 130 kgauss at 1.75 megawatts. Expressions for the G-factor, power per unit volume, heat flux, temperature rise, and burnout power are given for magnets using hexagonal patterns for axial cooling. (Contractor's abstract)

1755

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SEMICLASSICAL DISPERSION THEORY OF INTERBAND MAGNETO-OPTICAL EFFECTS, by J. Kolodziejczak, B. Lax, and Y. Nishina. [1962] [6]p. incl. refs. (AFOSR-J153) [AF 19(604)7344] Unclassified

Also published in Phys. Rev., v. 128: 2655-2660, Dec. 15, 1962.

From the classical equation of motion a conductivity tensor is derived for a bound electron in a dc external magnetic field. Then the conductivity for a circularly polarized wave is obtained, which is expanded in terms of the magnetic field. With the appropriate form of the oscillator strength for the interband transitions, the conductivity components are evaluated for the zeroth, first, and second power of the magnetic field over the 2 energy bands for the direct and the indirect transitions. The results are used to obtain expressions for the interband Faraday rotation and the Voigt phase shift in the limits of $\omega < \omega_g$ and $\omega > \omega_g$, where ω is optical frequency and ω_g the frequency corresponding to the energy gap. In the latter case oscillatory behavior is described by the expression near the frequency of singularities with a loss term in the form of relaxation time τ. (Contractor's abstract)

1756

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HIGH-FIELD SUPERCONDUCTIVITY IN NIOBIUM. by S. H. Autler, E. S. Rosenblum, and K. H. Gooen [1962] [5]p. incl. diagrs. table, refs. (AFOSR-J157) (Sponsored jointly by Air Force Office of Scientific Research under AF 19(604)7344, Office of Naval Research and Signal Corps) AD 400092 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 489-493, Dec. 15, 1962.

Experiments are described on the superconducting transition at high fields in niobium wires; from these it is inferred that there may be more than one mechanism involved and that pure niobium is a superconductor of the second kind.

1757

Massachusetts Inst of Tech. National Magnet Lab., Cambridge.

ZEEMAN AND UNIAXIAL STRESS SPECTRA OF $CaF_2(Eu^{2+})$, by W. A. Runciman and C. V. Stager. [1962] [2]p. incl. diagrs. (AFOSR-J274) [Sponsored jointly by Air Force Office of Scientific Research under AF 19(604)7344, Office of Naval Research, and Signal Corps] AD 400881 Unclassified

Also published in Jour. Chem. Phys., v. 38: 279-280 Jan. 1, 1963.

Results are given of a study of the splitting of the absorption line at 24 206 cm^{-1}. The Zeeman spectra were studied for fields from 17 to 90 kgauss, and are consistent with a separation of the f^6d state components which is 1.85 times that of the ground state components. The uniaxial stress spectra are similar to those found for $CaF_2(Sm^{2+})$ and indicate that the upper level belongs to the Γ_8 representation of the cubic group, the d electron being in an e orbit.

1758

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ZEEMAN EFFECT OF THE R LINES IN Cr_2O_3, by C. V. Stager. [1962] [2]p. incl. diagr. (AFOSR-J540) (AF 19-(604)7344) AD 408013 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1232-1233, Apr. 1963.

The Zeeman effect of the R lines at 4.2°K in fields up to 88 kOe was investigated. The magnetic field has been applied both parallel and perpendicular to the C_3 axis. When the external field is applied along the C_3 axis, all of the lines split into 2 components. No splitting is observed in the perpendicular orientation. As the Kramer's degeneracy has already been lifted by the exchange field, the splitting is attributed to the removal of a sublattice degeneracy. It is well known that the spin system of Cr_2O_3 will flip when a critical field of about 59 kOe is applied along the C_3 axis at 4.2°K. The spin-flop phenomenon has been seen in the optical spectra. From the splitting above the critical field there is tentative evidence of an anisotropic exchange interaction. (Contractor's abstract)

1759

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

MAGNETOELECTRIC EFFECTS IN Cr_2O_3 AND $(Cr_2O_3)_{0.8}\cdot(Al_2O_3)_{0.2}$, by S. Foner and M. Hanabusa. [1962] [2]p. incl. diagrs. refs. (AFOSR-J541) (AF 19(604)7344) AD 415316 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1246-1247, Apr. 1963.

Magnetic field induced magnetoelectric (ME) effects in Cr_2O_3 and $(Cr_2O_3)_{0.8}\cdot(Al_2O_3)_{0.2}$ have been examined with an ac method as a function of temperature and magnetic field. The ME effect parallel to the c axis reverses in sign at low temperatures for both materials, and is linear in H for all temperatures up to the spin-flop field H_C after which the ME effect approaches zero. The temperature dependence of the extrema of (dE dH) vs H leads to a measure of H_C vs T which agrees with earlier antiferromagnetic resonance and magnetic moment data in similar materials. Complete reversibility of the ME effect is observed when the magnetic field exceeds H_C and then returns to lower values, thus demonstrating a stable memory of the domain distribution introduced during magnetic annealing. Brief remarks are made on the angular dependence of the ME effect, and indications of nondiagonal contributions in the vicinity of H_C are mentioned. (Contractor's abstract)

1760

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

STABILIZATION AND CONTROL OF DC MAGNETIC FIELDS WITH SUPERCONDUCTING SOLENOIDS, by S. Foner. [1962] [3]p. incl. diagrs. (AFOSR-J594) (AF 19(604)7344) AD 414067 Unclassified

Also published in Rev. Scient. Instr., v. 34: 293-295, Mar. 1963.

The new high current superconductors can be used as diamagnetic shields in order to stabilize and control dc magnetic fields. Although solid cylinders or solenoids are practical, this note will discuss some useful characteristics of solenoid structures. With a nominal amount of superconducting material, structures can be devised which eliminate field changes over a given volume of a dc magnetic field and which simultaneoulsy permit precise control and variation of the magnetic field over the same volume. Some brief experimental results with such structures are presented.

1761

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

MAGNETOREFLECTION IN BISMUTH, by R. N. Brown, J. G. Mavroides, and B. Lax. [1962] [7]p. incl. diagrs. table, refs. (AFOSR-J596) (AF 19(604)7344) AD 414010 Unclassified

Also published in Phys. Rev., v. 129: 2055-2061, Mar. 1, 1963.

Direct interband transitions have been observed in the infrared magnetoreflection of single-crystal bismuth at low temperatures. They are manifested by oscillations which are almost periodic in 1/H. Analysis in terms of a 2-band model yields the energy gap, $\epsilon_g = 0.015 \pm 0.002$ ev, and also the cyclotron masses at the bottom of the conduction band for 2 orientations of the magnetic field with respect to the crystallographic axes. Within the resolution of the instrument, the g factors of the conduction and valence bands are equal. (Contractor's abstract)

1762

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

CRITICAL FIELD, ANTIFERROMAGNETIC RESONANCE IN Cr_2O_3 (Abstract), by S. Foner. [1962] [1]p. [AF 19-(604)7344] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 200-201, Mar. 26, 1962.

Earlier high-field, antiferromagnetic-resonance (AFMR) experiments at 35 and 70 kmc/sec have been extended in the critical-field region. Both high-magnetic fields and high frequencies are essential for such measurements. In addition to the zero-frequency, "spin flop" resonance and critical-field resonance (CFR) at 35 kmc/sec, the CFR has been examined in the narrow angular region with the applied field nearly parallel to the principal axis of Cr_2O_3 as a function of frequency, angle, field, and temperature. The results at 70, 95, and 116 kmc/sec are in good agreement with the earlier experiments and with computer calculations obtained with the molecular-field approximation for the CFR resonance and for the usual AFMR. The CFR and the usual AFMR are restricted to angles of less than 4 and 41 degrees, respectively, for the highest frequency, and to correspondingly smaller angles for lower frequencies. Some methods of observation and limitations of the small-angle resonance are also discussed.

1763

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

EFFECT OF UNIAXIAL STRESS ON THE SPECTRUM OF $CaF_2(Sm^{2+})$, by W. A. Runciman and C. V. Stager. [1962] [2]p. incl. diagrs. [AF 19(604)7344] Unclassified

Published in Jour. Chem. Phys., v. 37: 196-197, July 1, 1962.

The stress causes splitting of the absorption line at 14483 cm^{-1} and the shift to a lower wave number of the fluorescence line at 14110 cm^{-1}. These effects are interpreted on the basis of the energy level diagrams.

1764

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

FORCED-CONVECTION SURFACE-BOILING HEAT TRANSFER AND BURNOUT IN TUBES OF SMALL DIAMETER, by A. E. Bergles and W. M. Roshenow. May 25, 1962 [144]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 8757-21) (AF 19(604)7344) Unclassified

A heat-transfer apparatus was designed and constructed for the study of forced-convection boiling in small channels. In the region of low wall superheat, the heat flux can be predicted by available correlations for forced convection. Data indicate, however, that these correlations do not properly account for the radial variation of properties for water at high temperature difference. An analysis for the prediction of the inception of first significant boiling was developed. Experimental results are in good agreement with analytical predictions. The analysis provides information necessary for the prediction of the complete forced-convection surface-boiling curve. Data for a small-diameter tube indicate that the bubbles formed at incipient boiling can trip the laminar or transition boundary layer to a fully-developed turbulent boundary layer. The region of vigorous boiling coincides approximately with the extrapolation of the pool-boiling curve in one set of experiments. In other experiments, pool-boiling data were strongly influenced by fluid and surface conditions, as well as by bubble-induced convection in the pool. It is concluded that fully-developed forced-convection boiling can be related to pool boiling by either direct extrapolation or superposition of forced convection. Burnout flux increases with decreasing tube diameter. Flow oscillations caused by system compressibility can greatly reduce the burnout heat flux in the subcooled region. This instability is particularly difficult to avoid with tubes of very small diameter. (Contractor's abstract, modified)

1765

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HIGH-FIELD ANTIFERROMAGNETIC RESONANCE IN Cr_2O_3, S. Foner. [1962] [15]p. incl. illus. diagrs. table, 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. 130: 183-197, Apr. 1, 1963.

Antiferromagnetic resonance (AFMR) experiments in single-crystal Cr_2O_3 are summarized with specific emphasis on the high-field resonance mode. Most of the experiments involve pulsed magnetic fields and millimeter wavelength radiation. A brief description of the experimental techniques is included. The experimental results include AFMR as a function of temperature (from 4.2°K to the Neel temperature), frequency (36 to 135 kmc/sec), magnetic field, and angle between the magnetic field and the c axis. Results of the spin-flop resonance mode are also presented as a function of temperature, field, frequency, and angle. Magnetic measurements at the spin-flop and low-field static susceptibility measurement both parallel and perpendicular to the c axis are also given as a function of temperature. Normalized plots of the AFMR based on the molecular field approximation are presented as a function of angle and field and compared with experiment. The AFMR experiments agreed with the molecular field results when the static susceptibility data were included in the calculations. The characteristic quantity $(2 H_E H_A)^{\frac{1}{2}}$, where H_E is the exchange field and H_A is the anisotropy field, is 60 ± 3 kgauss from 4.2 to 235°K. The unusual temperature independence of $(2 H_E H_A)^{\frac{1}{2}}$ is partly accounted for by the crystalline field contribution to H_A which is only 700 gauss at 4.2°K. Assuming only dipolar and crystalline field contributions to H_A the crystalline field portion at low temperatures is 1000 gauss. This corresponds to an axial D contribution which is 1 9 that of Cr^{3+} in Al_2O_3 and of the opposite sign. More recent

optical and related data which confirm this result are discussed and some possible mechanisms of the unusual temperature dependence are indicated. A nonzero value of the parallel static susceptibility at low fields is also observed and briefly discussed. (Contractor's abstract)

1766

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

NONLINEAR INTERBAND AND PLASMA EFFECTS IN SOLIDS, by B. Lax, J. G. Mavroides, and D. F. Edwards. [1962] [3]p. incl. diagr. (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. Ltrs., v. 8: 166-168, Feb. 15, 1962.

The magnitude of second harmonic emission under stimulation by a ruby laser was measured for a number of piezoelectric and ferroelectric materials, and the results are discussed in terms of a semiclassical theory.

1767

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

OSCILLATORY INTERBAND VOIGT AND FARADAY EFFECTS IN GERMANIUM (Abstract), by Y. Nishina, J. K. Furdyna, Z. Ziejczak, and B. Lax. [1962] [1]p. [AF 19(604)-7
Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 535, Nov. 23-24, 1962.

The interband Voigt effect in germanium was measured for photon energies from 0.790-0.845 ev at room temperature in a 4-μ-thick sample in magnetic fields up to 59 kgauss. The rotation of a linearly polarized wave was measured by the technique previously described. From this, a plot of the Voigt phase shift vs photon energy was derived. The results showed the oscillatory behavior due to the direct transitions between the various lowest Landau levels observed in magnetoabsorption. Anisotropy of phase shift as well as energy was observed with magnetic fields along different crystal directions. With a phenomenological relaxation time, the line shapes of the interband Faraday rotation and Voigt effect were calculated from the semiclassical dispersion theory developed recently. The experimental results for the line shapes were in good qualitative agreement with those of the theory.

1768

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

OSCILLATORY QUANTUM EFFECTS IN THE ULTRASONIC VELOCITY IN BISMUTH, by J. G. Mavroides, B. Lax and others. [1962] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 19(604)7344], Atomic Energy Commission, Office of Naval Research, and [Signal Corps])
Unclassified

Published in Phys. Rev. Ltrs., v. 9: 451-453, Dec. 1, 1962.

Preliminary results are reported of observations of oscillatory changes in sound velocity in bismuth at 4°K as magnetic field is varied. These are presumed to arise from a quantum mechanism similar to the de Haas-van Alphen effect. Pulsed ultrasonic longitudinal waves of 20 and 33 mc/s were used, and a maximum $\Delta v/v$ of about 10^{-4} has been observed.

1769

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

PERSISTENT CURRENTS IN HOLLOW CYLINDERS OF NIOBIUM-TIN (Abstract), by F. Rothwarf, R. C. Thiel, and K. H. Gooen. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 19-(604)7344], Office of Naval Research, and Signal Corps)
Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 189, Mar. 26, 1962.

Persistent currents have been established in hollow cylinders of sintered niobium-tin by dc and pulsed magnetic fields at 4.2°K. Slowly varying fields produced a maximum persistent field of nearly 25 koe (corresponding to a current density of over 10^5 amp. cm^{-2}), while pulsed fields gave about 15 koe. In both cases, for increasing and decreasing fields, the internal axial field changed in steps. As H_{ext} was slowly increased, H_{int} remained constant until the samples momentarily become normal, permitting H_{ext} and H_{int} to equalize. H_{int} again remained constant if H_{ext} was reduced to zero. However, in pulsed fields (~ 10 msec rise, ~ 80 msec tail), H_{ext} and H_{int} usually did not equalize after a step. In cylinders 2.75 cm long x 1.6 cm o.d. x 0.7 cm i.d., the first step occurred for 10 koe < H_{ext} < 25 koe depending on on dH_{ext}/dt, the higher limit corresponding to lower rates. Further increase of H_{ext} gave rise to similar jumps of H_{int}. For unknown reasons, cylinders with thicker walls and/or larger outer diameters usually gave lower persistent fields.

1770

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THEORY OF INTERBAND FARADAY AND VOIGT EFFECTS IN SEMICONDUCTORS (Abstract) by B. Lax, Y. Nishina, and J. Kolodziejczak. [1962] [1]p. [AF 19-(604)7344] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 535, Nov. 23, 1962.

A quantum formulation of the conductivity tensor has been utilized to calculate the interband Faraday rotation and Voigt effect in a semiconductor with simple parabolic bands. Expansion as a function of a magnetic field for the circularly polarized components yields results for the Faraday rotation identical to the classical calculation and differ from those of Boswarwa, Howard, and Lidiard. An expression for the Voigt effect is also derived for photon energies both below and above that of the energy gap. The principal terms of interest for the oscillatory region of the Faraday and Voigt effects are of the same form for the quantum and classical theories and those given earlier. The theory can be used to explain the line shapes of the direct and indirect transitions.

1771

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ZEEMAN SPECTRUM OF EUROPIUM-ACTIVATED CALCIUM FLUORIDE (Abstract), by W. A. Runciman and C. V. Stager. [1962] [1]p. [AF 19(604)7344] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 196, Mar. 26, 1962.

The Zeeman splitting of the fluorescence line at 24206 cm^{-1} has been observed in crystals of $CaF_2(Eu^{2+})$ at 4.2°K in a field of 31 kgauss. The splitting of the same line is observed in absorption and, owing to depopulation of the higher levels of the ground state, only 6 lines are observed. At 20 kgauss 3 lines are observed and the whole pattern is believed to contain 10 major lines with a spacing appropriate to a Lande g factor of 2. The 6 central components show evidence of fine structure. A powdered sample shows the Zeeman pattern in fluorescence, indicating that the europium ions are cubic sites. Line intensities in the polarization spectra depend on the orientation of the crystal relative to the magnetic field. An energy-level diagram is proposed to account for the observed spectra. The ground state is known to be the $^8S_{7/2}$ state of the f^7 configuration, and it is suggested that the upper state belongs to the f^6d configuration. A large strain splitting of this line supports this assignment of the upper state.

1772

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ZEEMAN SPECTRUM OF SAMARIUM-ACTIVATED CALCIUM FLUORIDE (Abstract), by W. A. Runciman and C. V. Stager. [1962] [1]p. [AF 19(604)7344] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 85, Jan. 24, 1962.

The Zeeman splitting of the fluorescence line at 14111 cm^{-1} has been observed in crystals of CaF_2 (Sm^{++}) at 4.2°K in a field of 70 kgauss. The g value is about 1.3, considerably lower than the Russell-Saunders value of 1.5 for a $^7F_1$ level. The reduction is believed to be due to crystal field interactions. Polarization spectra obtained at 54 kgauss indicate that this transition, which is the one occurring in the optical maser, is electric dipole in nature. Hence the transition is believed to be $f^5d - f^6$ rather than $f^6 - f^6$. The absorption line at 14483 cm^{-1} shows no splitting, and one possible explanation of this is that the upper frequency difference of 116 cm^{-1} is vibrational in origin.

1773

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

EFFECTS OF EARLY PERCEPTUAL RESTRICTION ON SIMPLE VISUAL DISCRIMINATION, by R. Melzack. [1962] [2]p. incl. diagrs. (AFOSR-4191) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)898, 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 404996 Unclassified

Also published in Science, v. 137: 978-979, Sept. 21, 1962.

Dogs were raised from infancy to maturity in lighted cages that restricted their visual experience but did not deprive them of all patterned stimulation. After they were released from their cages, they had greater difficulty than normally reared littermates in performing a simple black-white discrimination and in subsequent reversal training. (Contractor's abstract)

1774

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

POWER AND ENERGY RELATIONS IN BIDIRECTIONAL WAVEGUIDES, by P. Chorney. [1962] [16]p. incl. diagrs. table. refs. (AFOSR-3391) (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

Also published in Electromagnetics and Fluid Dynamics of Gaseous Plasma, Proc. of the Symposium, New York (Apr. 4-6, 1961), Brooklyn, Polytechnic Press, v. 11: 195-210, 1962.

Some new general theorems on the propagation properties of a certain broad class of lossless, passive, uniform waveguides are developed. This broad class is referred to as bidirectional. Two important cases of bidirectional waveguides are: (1) those containing isotropic materials and (2) those containing gyrotropic materials with the gyrotropic axis along the waveguide axis. A feature of the materials considered is that they are, in general, dispersive. The theorems interrelate group velocity, phase velocity, power, energy, and pseudoenergy. The term pseudoenergy is used to distinguish the true energy from the energy-like terms which appear in the complex form of Poynting's theorem; for the case of dispersive media, true energy does not appear as such in the complex form of Poynting's theorem. As an illustration, these theorems are applied to the plasma-filled waveguide. Some general properties of the dispersion character are revealed. (Contractor's abstract)

1775

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ADAPTIVE DECISION PROCESSES, by J. L. Rosenfeld. Sept. 27, 1962, 82p. incl. diagrs. table, refs. (Technical rept. no. 403) (AFOSR-3974) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

General adaptive processes are described. In these processes, a measure of performance is increased as the experimenter gathers more information; the actions taken by the experimenter determine both the profit and the type of information gathered. In particular, the adaptive decision process is a 2-person, zero-sum, m x n game with some unknown payoffs. this game is played repeatedly. The true values of the unknown payoffs are learned only during those plays of the game at which the unknown payoffs are received. The players are given a priori probability distributions for the values of the unknown payoffs. A measure of performance is defined for the players of adaptive decision processes. An optimum strategy for one player is derived for the case in which the opponent uses one mixed strategy, known to the player, repeatedly. Optimum minimax strategies for both players are derived for the case in which the players are given the same information about the unknown payoffs. An optimum strategy, from a restricted class of strategies, is derived for one player when he is playing against nature, which is assumed to be an opponent whose strategy is unknown but is unfavorable to the player. (Contractor's abstract)

1776

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TEMPERATURE DEPENDENCE OF SPIN-SPIN SPLITTING IN THE HINDERED ROTATOR $CHCl_2$-CF_2Cl, by R. W. Fessenden and J. S. Waugh. [1962] [2]p. incl. diagrs. table, refs. (AFOSR-4970) (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)

Also published in Jour. Chem. Phys., v. 37: 1466-1467, Oct. 1, 1962.

The effective H^1-F^{19} spin coupling in $CHCl_2$—$CClF_2$ changes from 5.40 cps at -40°C to 5.60 cps at +100°C. This variation has been analyzed to obtain the difference in potential energy between the 2 energetically distinct staggered rotational isomers. The result is that the isomer possessing a plane of symmetry is either 2.0 kcal/mol more stable or 1.8 kcal/mol less stable than the other pair. The consequences of this result for the theory of spin-spin splitting are briefly discussed. (Contractor's abstract)

1777

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE EFFECT OF CLOSE COLLISIONS ON THE TWO-BODY DISTRIBUTION FUNCTION IN A PLASMA, by D. E. Baldwin. Dec. 31, 1962, 57p. incl. refs. (Technical rept. no. 402) (AFOSR-5014) (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 296211 Unclassified

The development of a 2-body distribution function in a plasma for use in a kinetic equation for the 1-body distribution function is investigated. The kinetic equation is obtained for a uniform plasma for those circumstances in which the time dependence of higher-order distribution functions can be assumed to occur within a functional dependence on the 1-particle distribution function. The conditions of validity for this functional-dependence assumption are discussed. The resulting interaction term is new in the sense that it contains no divergent integrals requiring cutoffs, and it may be considered accurate to first order in $(e^2/kT\lambda_D)$. The interaction term is composed of 2 parts. The first is a Boltzmann collision integral with a Debye-shielded interaction. The second term is due to the deviation of the shielding cloud from a Debye shield and is the Fokker-Planck form, the coefficients of which are finite and well-behaved. Because of its form, with a convergent integral and convergent Fokker-Planck coefficients, the solution may be considered as a joining of the previous solutions to this problem. (Contractor's abstract)

1778

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A COMMUNICATION ANALYSIS OF HIGH-FREQUENCY IONOSPHERIC SCATTERING, by G. Einarsson. Nov. 15, 1962, 76p. incl. illus. diagrs. refs. (Technical rept. no. 400) (AFOSR-5031) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 416605 Unclassified

A communication scheme for random multipath channels is investigated. During predetermined intervals the transmitter sends a sounding signal that the receiver uses to predict the behavior of the channel during the intermediate time when communication is performed. It is assumed that the channel varies slowly, and that the additive noise in the receiver is low. The possibility of representing a multipath channel as a time-variant filter is investigated. A sampling theorem for linear bandpass filters is derived, and the results that can be expected when it is used to represent a single fluctuating path with Doppler shift are discussed. The prediction operation is essentially linear extrapolation; a formula for the mean-square error is derived and compared with optimum linear prediction in a few cases. Calculations on actual data from ionospheric scattering communication show that the method is feasible and give good correspondence with the theoretical results. Under the assumption that the receiver makes decisions on each received waveform separately, and that there is no overlap between successive waveforms, the optimum receiver is derived. It consists mainly of a set of matched filters, one for each of the possible waveforms. The predicted value of the channel parameters is used in weighting the output from the matched filters to obtain likelihood ratios. This formulation provides means for dealing with random multipath channels in a way suitable for mathematical analysis. (Contractor's abstract, modified)

1779

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERTURBATION OF A PLASMA BY A PROBE, by J. F. Waymouth. Dec. 26, 1962 [44]p. incl. diagrs. tables, refs. (Technical rept. no. 406) (AFOSR-5033) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 296210 Unclassified

The perturbation of the plasma by a probe is analyzed as a problem in ambipolar diffusion, subject to the assumptions that the mean-free path of plasma particles is: (1) comparable to or smaller than probe dimensions, and (2) much greater than the thickness of any sheaths that may be present. Sheaths must therefore be assumed to be thin in comparison with probe dimensions. Analyses are carried through for spherical probes and for plane probes oriented normal to a magnetic field. The results can be expressed in terms of a parameter Q which is approximately equal at zero sheath potential to the sum of the ratios of probe size to electron mean-free path and probe size to ion mean-free path. Since Q also depends on sheath potential, the current-voltage characteristics are distorted. Methods for determining zero sheath potential, and calculating the properties of the undisturbed plasma from the probe curves are given. (Contractor's abstract, modified)

1780

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PRECISE CRITICAL-FIELD MEASUREMENTS OF SUPERCONDUCTING Sn FILMS IN THE LONDON LIMIT. by D. H. Douglass, Jr. and R. H. Blumberg. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-J173) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 400080 Unclassified

Also published in Phys. Rev., v. 127: 2038-2043, Sept. 15, 1962.

Precise measurements of the critical field of superconducting tin films were made as a function of temperature and thickness. Particular attention was paid to measurements near the transition temperature where the London limit holds. It was found that near the transition temperature the critical field could be expressed in the form $H_c = (\Delta t)^{1/2}\gamma(1 + \epsilon\Delta t)$, where γ and ϵ are independent of temperature. In terms of the Ginzburg-Landau theory modified to include the lower temperatures, the constant γ determines the penetration depth and the constant ϵ is different for different modifications of the field-independent free energy. Penetration depths determined in this way were found to be a function of thickness. Assuming that the coherence length ξ in the film is determined by the thickness and using the expression for the thickness dependence of the penetration depth given by Tinkham, one can obtain a bulk coherence length ξ_0 of approximately 2100A, as well as a bulk penetration depth of 510A, from the data. Two particular modifications of the Ginzburg-Landau theory are considered. The first, which is the original theory, predicts a value of $\epsilon = 0.31$. The second, which is the Gorter-Casimir modification proposed by Bardeen, predicts a value of $\epsilon = 0.19$. Experimentally, ϵ was determined to have an average value of 0.14 ± 0.10. (Contractor's abstract)

1781

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SELF-DIFFUSION AND IMPURITY-CONTROLLED PROTON RELAXATION IN LIQUID ETHANE, by J. V. Gaven, W. H. Stockmayer, and J. S. Waugh. [1962] [4]p. incl. diagrs. refs. (AFOSR-J124) (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 400082 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1188-1191, Sept. 15, 1962.

Self-diffusion in liquid ethane, under its own vapor pressure has been studied over most of the liquid range between the triple point and the critical point. The activation energy for self-diffusion increases markedly from approximately 0.5 kcal/mol at 100°K to 3.5 kcal/mol at 300°K. The Stokes-Einstein relation is not well satisfied with either a constant molecular radius or a radius proportional to the cube root of the molar volume. The results are well correlated by a free-volume expression in which the free volume, defined as an actual volume minus the volume of the hypothetical liquid at 0°K, replaces temperature as the independent variable. The value of the hypothetical 0°K liquid volume resulting in best fit of the experimental data is less than that determined by extrapolation of the liquid specific volume to 0 K or that based upon best fit of experimental liquid viscosity data, but it is between a value based on a hard-sphere radius determined from gas viscosity and one derived from the second virial coefficient. Proton spin-lattice relaxation measurements on the liquid ethane sample over a similar temperature range indicate that the relaxation is controlled by mutual diffusion of ethane and small amounts of dissolved oxygen, although the situation is somewhat complicated by temperature dependence of the distribution of oxygen between the 2 phases. (Contractor's abstract)

1782

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELECTROHYDRODYNAMIC AND MAGNETOHYDRODYNAMIC NONLINEAR SURFACE WAVES, by J. R. Melcher. [1962] 1v. incl. diagrs. (AFOSR-J125) (Sponsored jointly by Aeronautical Systems Division; Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 400081 Unclassified

Also published in Phys. Fluids, v. 5: 1037-1043, Sept. 1962.

A nonlinear formulation of electrohydrodynamic and magnetohydrodynamic surface interactions is developed which, in the absence of magnetic or electric fields, becomes the classical "long" gravity-wave theory. The results are valid for a shallow highly conducting fluid that interacts strongly with a rigid highly conducting plate in such a way as to either conserve an electric potential difference or a magnetic flux. The growth of surface discontinuities from compression and depression waves is discussed, with transition electrohydrodynamic waves originating from timelike data given to illustrate waves that are partly controlled by gravity and partly by the electric field. Waves initiated from spacelike data are also described, and the integral jump conditions derived. (Contractor's abstract)

1783

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TWO-QUANTUM TRANSITIONS IN THE MICROWAVE MAGNETIC RESONANCE SPECTRUM OF ATOMIC CHLORINE, by G. J. Wolga. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-J978) (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 Phys. Rev., v. 127: 805-812, Aug. 1, 1962.

Two-quantum microwave magnetic resonance transitions corresponding to $\Delta M_J = \pm 2$ have been observed for both stable isotopes of atomic chlorine, Cl^{35} and Cl^{37}. The experimentally observed and theoretically predicted positions of the 2 quantum transitions agree within 13 parts per million, which was the precision of the experiment. The power dependence of the 2 quantum transitions has been measured and checked with a "variation of constants" treatment of the microwave-induced probability amplitudes, and agreement has been found. Variations in intensity between corresponding $\Delta M_J = \pm 1$ and $\Delta M_J = \pm 2$ resonances were observed and analyzed on the basis of time-dependent perturbation theory and the Schwinger-Karplus expression for the line shape of a collision-broadened resonance with saturation. Satisfactory agreement with theory is found for these intensity variations. The linewidths for the $\Delta M_J = \pm 2$ lines are approximately half of that for the $\Delta M_J = \pm 1$ lines; this is in agreement with the results of time-dependent perturbation theory. (Contractor's abstract)

1784

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EFFECT OF ELECTROSTATIC INTERACTIONS ON THE NUCLEAR MAGNETIC RESONANCE DIPOLAR HYPERFINE STRUCTURE WITH STRONG CORRELATION-TIME NARROWING, by M. W. P. Strandberg. [1962] [6]p. (AFOSR-J979) (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 Phys. Rev., v. 127: 1162-1167, Aug. 15, 1962.

The effect of electric fields on the nuclear magnetic resonance dipolar hyperfine spectrum of a liquid with correlation-time narrowing is examined. A first-order molecular quadrupole effect and a second-order molecular electric dipole effect (Stark effect) of observable magnitude are predicted. The results are discussed with reference to the proton magnetic resonance in water. (Contractor's abstract)

1785

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

VELOCITY OF SOUND IN LIQUID HELIUM AT LOW TEMPERATURES, by W. M. Whitney and C. E. Chase. [1962] [3]p. incl. diagr. (AFOSR-J981) (Sponsored

jointly by Advanced Research Projects Agency; 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 U., Seattle, Aug. 27-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 472, Aug. 27, 1962. (Title varies)

Also published in Phys. Rev. Ltrs., v. 9: 243-245, Sept. 15, 1962.

The velocity of sound in liquid helium under its saturated vapor pressure has been measured at 1 mc/sec between 0.15 and 1.4°K with a resolution of approximately 1 part in 10^4 using a phase-comparison technique previously described. Near 0°K, the velocity is independent of temperature. With increasing temperature the velocity increases slightly, passing through a maximum in the vicinity of 0.65°K, and then falling almost linearly between this temperature and 0.9°K, with a slope of -1.6 m/sec-°K. At higher temperatures, the rate of decrease is more rapid. Between 0.15° and 1.4°K, the total decrease in the velocity is 1.9 ± 0.1 m/sec. The attenuation was also observed at this frequency. Its behavior is consistent with that reported in the preceding paper, its maximum occurring at 0.75°K.

1786

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SUPERCONDUCTING TRANSITION TEMPERATURE OF SUPERIMPOSED FILMS OF TIN AND SILVER, by W. A. Simmons and D. H. Douglass, Jr. [1962] [3]p. incl. diagrs. (AFOSR-J982) (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 Phys. Rev. Ltrs., v. 9: 153-155, Aug. 15, 1962.

The depression of the superconducting transition temperature of thin films of tin by superimposed films of silver and cobalt was observed and compared with theory.

1787

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THOMSON SCATTERING OF OPTICAL RADIATION FROM AN ELECTRON BEAM, by G. Flocco and E. Thompson. [1962] [3]p. incl. illus. diagr. table. (AFOSR-J983) (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

Also published in Phys. Rev. Ltrs., v. 10: 89-91, Feb. 1, 1963.

Light from a ruby laser was focused to intersect a magnetically confined electron beam perpendicularly, and the scattered radiation was detected at an angle of 56° to the electron beam (90° to the laser beam). The intensity of the detected radiation was 10^{18} of the laser output. The number of photoelectrons produced in the detector due to Thomson scattering was close to the value predicted from the scattering cross-sections. Allowance was made for the effects of scattering of laser light other than by the electron beam and for the optical radiation generated by the electron beam and electron source.

1788

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INTERACTIONS BETWEEN SOUND WAVES, by L. W. Dean, III. [1962] [6]p. incl. diagrs. (AFOSR-J984) (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 Jour. Acoust. Soc. Amer., v. 34: 1039-1044, Aug. 1962.

Exact solutions for the interaction between 2 concentric cylindrical waves and between 2 concentric spherical waves are presented. The scattered-pressure amplitude in the far field is shown to be constant in the cylindrical case and to be proportional to r^{-1} ln r in the spherical case, where r is the distance to the source of primary waves. A near-field solution is derived for the scattered waves generated when 2 sharply defined, plane-wave beams of square cross section intersect at right angles. A comparison is made of the theory with recent experiments in which beams of circular cross section were used. It is concluded that if the scattered waves do exist, their amplitudes are at least 40 db below those that are predicted by this theory. When a hard object is placed in the region of intersection, scattered waves are observed. This effect can be explained by the fact that with the addition of the hard object (a cylinder) the primary waves have components of the same symmetry. These components are the waves scattered from the primary beams by the object. Evidence is presented to show that these components, having the same symmetry, interact strongly in the volume surrounding the object. (Contractor's abstract)

1789

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERCEPTION OF TWO-COMPONENT NOISE BURSTS, by K. N. Stevens, R. R. Sandel, and A. S. House. [1962] [3]p. incl. diagrs. (AFCRL 63-179) (AFOSR-J985) (Sponsored jointly by Air Force Cambridge Research Lab.; Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and National Science Foundation) Unclassified

Also published in Jour. Acoust Soc. Amer., v. 34: 1876-1878, Dec. 1962.

In a series of experiments, listeners were asked to make judgments of the relative duration, loudness, and stress associated with the components of stimuli consisting of sequences of 2 noise bursts. The over all duration of each stimulus was the same, and the 2 components were given various relative intensities and durations. All response sets demonstrate a marked asymmetry, particularly those requiring a judgment of the stress pattern of the sequence. (Contractor's abstract)

1790

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TANDEM USE OF GRATINGS AND ECHELLES TO INCREASE RESOLUTION, LUMINOSITY, AND COMPACTNESS OF SPECTROMETERS AND SPECTROGRAPHS, by G. W. Stroke and H. H. Stroke. [1962] [6]p. incl. illus. diagrs. refs. (AFOSR-J986) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 403615 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 333-338, Mar. 1963.

The principle of tandem (series) arrangements of spectroscopic elements—used with prisms in 1861 by Kirchhoff and Bunsen, later applied to Fabry-Perot étalons, and more recently to concave gratings in the soft x-ray domain—has been successfully extended to high-resolution gratings and echelles. For example, when 2 gratings are used in series near autocollimation, the resolving power is doubled as compared with a single element at the same angle. Moreover, for a given linear dispersion, the luminosity may be increased up to a factor of 4 (for perfect reflectivity and blaze), since the doubled angular dispersion within a constant aperture permits the reduction of focal length by a factor of 2. The advantages pointed out here also characterize multiple-pass arrangements, first described for prisms by Wadsworth in 1895 and again emphasized by Couderc, Jacquinot, and Walt... and for gratings by Hulthén, Rank, and others. These advantages indicate the possibility of extending multiple-pass arrangements to the use of echelles when the additional mirror reflection is acceptable. Design characteristics for tandem use of gratings in monochromators and for tandem use of high-order gratings (echelettes, echelles) in broad-range spectrograph arrangements, as well as experimental results, are presented. The single-echelette (echelle) spectrograph arrangement which is basic to the tandem extension is that first suggested by Shane and mounted, crossed with a prism, by Wood in 1947, and similarly mounted, crossed with a grating, by Harrison, Archer, and Camus in 1952. In the tandem arrangement only simple geometrical alignment, with no phase adjustment between the 2 gratings, is required, unlike the mounting for grating mosaics with several coplanar gratings. (Contractor's abstract)

1791

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

FAR-INFRARED INTERFEROMETER FOR THE MEASUREMENT OF HIGH ELECTRON DENSITIES, by S. C. Brown, G. Bekefi, and R. E. Whitney. [1962] [6]p. incl. illus. diagrs. table. (AFOSR-J987) (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., Northwestern U., Evanston, Ill., June 19-21, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 413, June 19, 1962.

Also published in Jour. Opt. Soc. Amer., v. 53: 448-453, Apr. 1963.

The average electron concentration of a gas-discharge plasma can be inferred from the phase change suffered by an electromagnetic wave in its passage through the medium. With available microwave generators, the maximum electron density that can be measured is approximately 3×10^{14} cm^{-3}. On the other hand, interferometers that operate at optical wavelengths become insensitive at electron densities less than approximately 10^{16} cm^{-3}. An infrared interferometer is described here which operates at 0.03 cm wavelength and is able to detect densities above 5×10^{13} cm^{-3} in a plasma column 1-cm thick. In the design, incoherent radiation from a mercury arc lamp is split by a diffraction grating and the plasma placed in one of the diffracted beams. The beams are then recombined and fringe shifts measured by a Golay detector. (Contractor's abstract)

1792

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A MULTIPLE CHANNEL EEG TELEMETERING SYSTEM, by F. T. Hambrecht, P. D. Donahue, and R. Melzack. [1962] [4]p. incl. illus. diagrs. (AFOSR-J989) (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

Also published in Electroencephalog. and Clin. Neurophysiol., v. 15: 323-326, Apr. 1963.

A 4-channel EEG telemetering system is described. Detailed diagrams of the components of the system and of oscillators used for calibration and adjustment of the demodulators are provided.

1793

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THERMAL NOISE IN LINEAR, LOSSY, ELECTROMAGNETIC MEDIA, by M. Vanwormhoudt and H. A. Haus. [1962] [6]p. incl. diagr. (AFOSR-J991) (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 Jour. Appl. Phys., v. 33: 2572-2577, Aug. 1962.

The thermal radiation of lossy media is described by a random current-source term that is introduced into Maxwell's equations. The media treated are linear, in general anisotropic, nonuniform, and such that the constituent relations are not local relations, but are described in terms of a Green's operator. For such media, in thermodynamic equilibrium, it is shown that simple relations exist between the correlation and spectral density matrices of the random current-source field and the Green's conductivity operator. These relations are analogous to Nyquist's theorem of lumped circuits. (Contractor's abstract)

1794

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CONTAINMENT OF PLASMAS BY HIGH-FREQUENCY ELECTRIC FIELDS, by M. Ericson, C. S. Ward, and others. [1962] [6]p. incl. illus. diagrs. refs. (AFOSR-J992) (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, North Atlantic Treaty Organization, and the Phillippe Foundation) Unclassified

Also published in Jour. Appl. Phys., v. 33: 2429-2434, Aug. 1962.

A cylindrical plasma column was produced in hydrogen by a microwave electric field crossed with a static magnetic field. Under certain conditions of gas pressure, magnetic field, and strength of the microwave field, the plasma did not entirely fill the volume available to it but appeared as a narrow, perfectly stable, cylindrical column with a diameter as small as 1/4 of the diameter of the discharge tube. The experimentally observed properties of this "constricted" discharge are described. It is shown that they can be explained by treating the plasma as a compressible dielectric medium. (Contractor's abstract)

1795

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CLOSE COLLISIONS IN A PLASMA, by D. E. Baldwin. [1962] [8]p. (AFOSR-J995) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 410054 Unclassified

Also published in Phys. Fluids, v. 5: 1523-1530, Dec. 1962.

A 2-body distribution function in a plasma is developed for use in a kinetic equation for the 1-body distribution function. The kinetic equation is obtained for a uniform plasma for circumstances in which the time dependence of higher-order distribution functions can be assumed to occur within a functional dependence on the 1-particle distribution function. The resulting interaction term is new, in the sense that it contains no divergent integrals, and is considered accurate to first order in $(e^2/KT\lambda_D)$. The interaction term is composed of 2 parts. The first is a Boltzmann collision integral with a Debye-shielded interaction. The second term is due to the deviation of the shielding cloud from a Debye shield and is of the Fokker-Planck form, the coefficients of which are finite and well behaved. Because of its form, with a convergent collision integral and convergent Fokker-Planck coefficients, the solution may be considered a joining of the previous solutions to the problem. (Contractor's abstract)

1796

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE RELAXATION SPECTRUM OF NICKEL-TRIGLYCINE COMPLEXES, by J. I. Steinfeld and G. G. Hammes. [1962] [3]p. incl. tables. (AFOSR-J996) (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

Also published in Jour. Phys. Chem., v. 67: 528-530, Feb. 1963.

The rate constants for formation of mono- di- and tritriglycine complexes of Ni(II) were determined from relaxation time measurements, as an extension of previous work on diglycine. The complexes of Ni(II) with triglycine were studied in order to observe the effects of increasing the size and complexity of the ligand.

1797

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SKIN SENSITIVITY TO THERMAL STIMULI, by R. Melzack, G. Rose, and D. McGinty. [1962] [14]p. incl. illus. refs. (AFOSR-J997) (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

Also published in Exper. Neurol., v. 6: 300-314, Oct. 1962.

Distribution patterns of cutaneous thermal sensitivity in human subjects were studied by mapping large areas of skin with stimulators the tip temperatures and diameters of which were controlled. The maps show that skin sensitivity to cold and warm stimuli is distributed in the form of large sensory fields rather than isolated "spots" These sensory fields have a variety of sizes and shapes. Generally, they consist of highly sensitive areas, ranging in size from 6 cm^2 to spot-like peaks, surrounded by larger, less sensitive regions. Moreover, there are persistent fluctuations of thermal sensitivity in successive maps of the same area of skin. Fluctuation usually took 2 forms: marked changes primarily at the boundaries of the sensory fields; and "fragmentation" and "coalescence" of the fields themselves. It was also observed that small, warm stimuli produce frequent reports of pricking, stinging sensations at temperatures that evoke pleasant warmth when applied normally to large areas of skin. This observation suggests that the spatial properties of warm stimuli play an important role in determining the quality of cutaneous experience. (Contractor's abstract)

1798

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOME PROPERTIES OF THE AFFERENT PATHWAY IN THE FROG CORNEAL REFLEX, by K. Kornacker. [1962] [16]p. incl. diagrs. refs. (AFOSR-J998) (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., National Institutes of Health, and Teagle Foundation, Inc.) Unclassified

Also published in Exper. Neurol., v. 7: 224-239. Jan. 1963.

An electrophysiological method was used to examine the neurological basis of stimulus specificity in the frog corneal reflex. Anesthetized frogs possessing an intact corneal reflex were stimulated in a variety of ways and source density maps were constructed from the synaptic potentials recorded in the medulla oblongata at the level of the abducens nucleus. These maps, considered in relation to the effectiveness of the various stimuli for producing an eye retraction, suggest a set of characteristic physiological properties for the afferent nerve fibers which lie in the frog corneal reflex pathway. There appears to be a 100-μ separation in the medulla between the sites of termination of 2 groups of afferent myelinated nerve fibers. One group, consisting of the fastest conducting fibers, terminates medially, while the other group, consisting of fibers having a slower conduction velocity and a higher electrical threshold, terminates laterally. Two results further suggest that the frog corneal reflex may involve only those fibers which terminate in the lateral locus. First, the reflex motor cell response which follows an effective stimulation of the snout does not occur until 1 or 2 msec after the appearance of lateral activity, in spite of the much greater medial activity which occurs 2 msec before the lateral activity. Secondly, the activity following corneal stimulation is completely confined to the lateral locus. These results also suggest that the stimulus specificity of the frog corneal reflex rests simply on the relatively high density of small diameter fibers terminating peripherally in the cornea and centrally in the lateral locus. Finally, it is shown how ischemia could account for the abnormal eye reflexes which have been induced in amphibia by transplantation.

1799

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A NEW UPPER LIMIT TO THE GALACTIC DEUTERIUM-TO-HYDROGEN RATIO, by S. Weinreb. [1962] [2]p. incl. diagr. refs. (AFOSR-J999) (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

Also published in Nature, v. 195: 367-368, July 1962.

Four switched multichannel receivers simultaneously measured the absorption spectrum of Cassiopeia-A in the region of the 327 mc/s deuterium line. Integration over an effective observing time of 6.6 x 10^6 sec shows that the deuterium-to-hydrogen ratio in the region studied is less than 1/13,000.

1800

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A METHOD FOR THE DETERMINATION OF HIGH-ALTITUDE WATER VAPOR ABUNDANCE FROM GROUND-BASED MICROWAVE OBSERVATIONS, by A. H. Barrett and V. K. Chung. [1962] [8]p. incl. diagrs. refs. (AFOSR-J1005) (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 Jour. Geophys. Research, v. 67: 4259-4266, Oct. 1962.

The microwave resonance line at 22,235 mc/s (λ = 1.35 cm) arising from uncondensed H_2O in the terrestrial atmosphere is examined in detail as a means of providing easily obtained data on the physical structure of the atmosphere. It is shown that the line profile is drastically influenced by the vertical distribution of H_2O and that the anomalous abundance of uncondensed H_2O above 15 to 20 km should be easily detected and monitored by ground-based passive microwave observations. The method, capable of 24 hr/day operation, can be used to determine abundance changes on a time scale as short as several seconds, if necessary, and to reveal horizontal fine structure with a resolution of 150 m at an altitude of 30 km with a 10-ft parabolic receiving antenna. Other atmospheric constituents that have microwave resonance spectrums, for example O_3, are amenable to study by this procedure. (Contractor's abstract)

1801

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE COLLOQUY OF LIVING THINGS, by W. S. McCulloch. [1962] [9]p. incl. illus. (AFOSR-J1006) (Sponsored jointly by Aeronautical Systems Division; 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

Also published in Bio-Telemetry, Proc. of Interdisciplinary Conf. on the Use of Telemetry in Animal Behavior and Physiology in Relation to Ecological Problems, New York (Mar. 28-31, 1962), ed. by L. E. Slater. New York, Pergamon Press, 1965, p. 3-11.

A brief description of the background of the meeting called "the colloquy of living things" is given. These meetings deal with cybernetics (a study of circular causal or feedback processes). Participants from varying scientific fields took part in these meetings. A synopsis is given of major achievements in the following areas: (1) three laws crucial to biology; (2) mathematics and biology; (3) make-up of the tape; and (4) proteins and learning.

1802

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE ENERGY DISTRIBUTION FOR ELECTRONS IN A THERMIONIC DIODE PLASMA CANNOT BE TRULY MAXWELLIAN, by W. B. Nottingham. [1962] [21]p. incl. diagrs. table. (AFOSR-J.119) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 403611 Unclassified

Also published in Advanced Energy Conversion, v. 2: 467-479, 1962.

For abstract see Part II of item no. 1850, Vol. VI.

1803

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DESIGN PARAMETERS' INFLUENCE ON M.I.T. BAYARD-ALPERT GAUGE SENSITIVITY, by W. B. Nottingham. [1961] [5]p. incl. diagrs. tables. (AFOSR-J1385) (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 1961 Trans. Eighth Nat'l. Vacuum Symposium combined with Second Internat'l. Cong. on Vacuum Science and Technology, Washington, D. C. (Oct. 16-19, 1961), ed. by L. E. Preuss. New York, Pergamon Press, v. 1: 494-498, 1962.

The Bayard-Alpert gages studied all had a screen grid between the electron emitting filament and the glass wall. Ion currents observed at the normal, small wire ion collector inside of the electron collector and also on the screen were studied as a function of the electron emission current as measured at the filament and the pressure of nitrogen. The parameters investigated were the distance between the electron emitting filament and the electron collector, and the design of the electron collector. Although the ion current observed at the normal collector showed a strong nonlinearity with increasing electron current at higher pressures, the total ion current was remarkably linear. Gage sensitivity K decreases by a factor of 2 as the filament-to-electron collector spacing is reduced from 3 mm to 1 mm. The closing of the electron collector with fine wires increases the sensitivity by a factor of 3.1 compared to the open-ended structure. At the high pressure of $p = (10^{-4}$ Torr), the gage constant decreases and the limit of pressure variation detection comes at Kp = 1.7 for a 100 v electron acceleration potential. (Contractor's abstract)

1804

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROGRAM FOR ACTIVE SEGMENTATION AND REDUCTION OF PHONETIC PARAMETERS, by S. Inomata. [1962] [4]p. incl. diagrs. (AFOSR-J1547) (Sponsored jointly by Air Force Cambridge Research Labs., 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 Fourth Internat'l. Cong. on Acoustics, Copenhagen (Denmark), Aug. 21-28, 1962.

The present paper examines the problem of determining a set of quasi-discrete or ideal phonetic parameters when a set of continuous phonetic parameters is given. The input to the analyzer consists of a set of continuous phonetic parameters that describe certain continuous articulatory motions. In the present experiments, the input phonetic parameters are derived from measurements on cineradiographic films. The output of the analyzer consists of a set of ideal quasi-discrete phonetic parameters. The internal generative model simulates the above-mentioned articulatory processes, it accepts ideal phonetic parameters at its input, and operates on these to yield continuous phonetic parameters at its output. Comparison is made between the input and the internally-generated parameters, and new inputs to the internal model are tried until a best match is obtained in the comparator. Preliminary analysis and segmentation are carried out in order to obtain approximate first guesses for the ideal parameters. In the preliminary studies described here, 4 parameters $f_i(t)$, $i = 1-4$, were selected tentatively as input signals. Frame-by-frame measurements from the films were used to obtain input parameters for the final syllable of several utterances of the form $/ha\ C_1VC_2$, where the initial and final consonants C_1 and C_2 are identical. As a result of the preliminary analysis, tentative values for 20 parameters are obtained. These consist of the 3 time segmentation points (2 for each parameter) and the values of 12 ideal phonetic parameters.

1805

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ACOUSTICAL DESCRIPTION OF SYLLABIC NUCLEI: DATA DERIVED BY AUTOMATIC ANALYSIS PROCEDURES, by A. S. House, A. P. Paul and others. [1962] [4]p. incl. diagrs. (AFOSR-J1548) (Sponsored jointly by Air Force Cambridge Research Labs., 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 Fourth Internat'l. Cong. on Acoustics, Copenhagen (Denmark), Aug. 21-28, 1962.

The automatic computational methods and the data reduction procedures outlined in this paper appear to provide simple yet accurate descriptions of time-varying articulatory events throughout the vocalic portions of speech. The procedures have been used to analyze an ensemble of speech materials.

1806

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN ANALYSIS OF SPEECH SPECTRA IN TERMS OF A MODEL OF ARTICULATION, by J. M. Heinz. [1962] [4]p. incl. diagrs. refs. (AFOSR-J1549) (Sponsored jointly by Air Force Cambridge Research Lab. 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 Fourth Internat'l. Cong. on Acoustics, Copenhagen (Denmark), Aug. 21-28, 1962.

It is possible with the programs outlined here to compare an internally generated spectrum with an actual speech spectrum and to vary manually the input parameters until an optimum match is obtained. The results of the match are parameters which relate to the physical dimensions of the vocal tract and thus make it possible to study the dynamics of the articulatory system through analyses of the acoustic signal.

1807

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ACOUSTICAL DESCRIPTION OF SYLLABIC NUCLEI: AN INTERPRETATION IN TERMS OF A DYNAMIC MODEL OF ARTICULATION, by A. S. House, K. N. Stevens, and A. P. Paul. [1962] [4]p. incl. diagrs. (AFOSR-J1550) (Sponsored jointly by Air Force Cambridge Research Labs., 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 Fourth Internat'l. Cong. on Acoustics, Copenhagen (Denmark), Aug. 21-28, 1962.

Formant frequency values F_{10} and F_{20} are studied along with the curvature values. A postdental consonant, which is known to have a relatively stable place of articulation, is examined in different vowel contexts. Results show that consonantal context appears to have the greatest influence on the value of F_{20} for rounded vowels. In all cases, the effect is such that the extremal value of the second formant frequency is displaced from the ideal target value toward the frequency of the consonantal locus. In articulatory terms, this suggests that there is an effective inertia in the articulatory processes giving rise to undershoot in the system response during the production of syllabic nuclei. Such an interpretation has implications in the formulation of theories of speech perception and in the design of machines for speech recognition.

1808

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A PROPERTY OF PARTIALLY SPECIFIED AUTOMATA, by C. L. Liu. [1962] [8]p. incl. tables. (AFOSR-64-0308) (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 Inform. and Control, v. 6: 169-176, Sept. 1963.

A partially specified finite automaton is one whose flow table is not completely specified. Given a partially specified automaton, an attempt is made to determine whether it is possible to complete the flow table so that the resultant automaton will have a finite memory span.

1809

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PLASMA DIFFUSION IN A MAGNETIC FIELD, by D. R. Whitehouse and H. B. Wollman. [1962] [9]p. incl. diagrs. refs. (AFOSR-64-0324) (Sponsored jointly by [Air Force Cambridge Research Labs.], Air Force Office of Scientific Research, Office of Naval Research, and [Signal Corps] under DA 36-039-sc-78108, and Atomic Energy Commission) Unclassified

Also published in Phys. Fluids, v. 6: 1470-1478, Oct. 1963.

The 2-dimensional diffusion of a partially ionized plasma in a magnetic field is studied using the macroscopic plasma equations. For a stable steady-state plasma with uniform electron temperature and ionization frequency, it is shown that the density distribution can exist only in the lowest mode by virtue of the internal constraint that the space charge potential is conservative. While the electron and ion diffusion currents in an insulating cavity are everywhere equal, similar to Schottky's ambipolar diffusion theory for 1 dimension, the plasma in a conducting cavity exhibits an increase in the net particle current to the walls and an unbalance of ion and

electron currents in the plasma. Thus an amperian current flows through the plasma and returns through the walls. With adjustable dc potentials applied to the walls of a split cavity, these currents may be continuously varied and even decreased below those given by the ambipolar condition. An experiment with a microwave cavity discharge demonstrates the existence of these unbalanced currents. (Contractor's abstract)

1810

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NEUROLOGICAL MODELS AND INTEGRATIVE PROCESSES, by W. S. McCulloch, M. A. Arbib, and J. D. Cowan. [1962] [11]p. incl. refs. (AFOSR-64-0696) (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

Also published in Self Organizing Systems, Proc. of the Conf., Chicago, Ill. (May 22-24, 1962), ed. by M. C. Yovits, G. T. Jacobi, and G. D. Goldstein. Washington, Spartan Books, 1962, p. 49-59.

The chief concern of this paper is the modeling of the functional organization of the nervous system. Results are presented in very general form, without formal definitions, theorem, or proofs. One main field of interest is the construction of models of nervous circuit whose input-output functions remains constant under shifts of threshold, such as chemical and temperature changes. Another area of research shows how to design neurological nets with one rank of any number of components each with inputs from the same number of sources, and all of the first rank playing upon a single output component. Finally, the validity of Shannon's noisy coding theorem under certain assumptions for computing networks has been demonstrated, so that error-correcting codes may be used to combat failures and malfunctions of computing components.

1811

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THEORY OF THE ANALYSIS OF NONLINEAR SYSTEMS, by M. B. Brilliant. Mar. 3, 1958, 58p. incl. diagrs. refs. (Technical rept. no. 345) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

A theory of the analysis of nonlinear systems is developed. The central problem is the mathematical representation of the dependence of the value of the output of such systems on the present and past of the input. It is shown that these systems can be considered as generalized functions, and that many mathematical methods used for the representation of functions of a real variable, particularly tables of values, polynomials, and expansions in series of orthogonal functions, can be used in generalized form for nonlinear systems. The discussion is restricted to time-invariant systems with bounded inputs. A definition of a continuous system is given, and it is shown that any continuous system can be approximately represented, with the error as small as may be required, by the methods mentioned above. Roughly described, a continuous system is one that is relatively insensitive to small changes in the input, to rapid fluctuations (high frequencies) in the input, and to the remote past of the input. A system is called analytic if it can be exactly represented by a certain formula that is a power-series generalization of the convolution integral. This formula can represent not only continuous systems but also no-memory nonlinear systems. Methods are derived for calculating, in analytic form, the results of inversion, addition, multiplication, cascade combination, and simple feedback connection of analytic systems. The resulting series is proved to be convergent under certain conditions, and bounds are derived for the radius of convergence, the output, and the error incurred by using only the first few terms. Methods are suggested for the experimental determination of analytic representations for given systems. (Contractor's abstract)

1812

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CONSTRUCTION OF CONVOLUTION CODES BY SUB-OPTIMIZATION, by M. A. Epstein. Nov. 18, 1959, 20p. incl. diagrs. table, refs. (Technical rept. no. 341) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under DA 36-039-sc-78108) Unclassified

A procedure for suboptimizing the choice of convolution codes is described. It is known that random convolution codes that have been passed through a binary symmetric channel, or a binary erasure channel, have a low probability of error and are easily decoded, but no practical procedure for finding the optimum convolution code for long code lengths is known. A convolution code is defined by its generator. It is proved that by sequentially choosing the generator digits, one can obtain a code whose probability of error decreases as fast as, or faster than, the usual upper bound for a random code. Little effort is required for suboptimizing the choice of the first few generator digits. This effort increases exponentially with the choice of successive generator digits. For a rate of transmission equal to 1/2, and the given procedure, a code of length 50 is the approximate limit, with the use of presently available digital computers. (Contractor's abstract)

1813

Massachusetts Inst. of Tech. Research Lab. of Electronics Cambridge.

DIFFRACTION OF A PLANE SOUND WAVE BY A SEMI-INFINITE THIN ELASTIC PLATE, by G. L. Lamb, Jr. [1959] [7]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. Acoust. Soc. Amer., v. 31: 929-935. July 1959.

The diffraction of a plane small amplitude sound wave incident upon a semi-infinite thin elastic plate is investigated theoretically. The problem is formulated in terms of an integral equation relating the discontinuity in pressure across the diffracting plate to its flexural displacement and the usual fourth order thin plate differential equation governing the flexural motion of the plate when driven by the pressure discontinuity. This pair of coupled equations is then shown to be amenable to solution by the Wiener-Hopf method. A perturbation procedure, valid in the limit of increasing plate stiffness, is employed to obtain expressions for the sound fields radiated by and transmitted through the plate as well as for the diffracted sound field. (Contractor's abstract)

1814

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE SOUND PATTERN OF RUSSIAN: A LINGUISTIC AND ACOUSTICAL INVESTIGATION, by M. Halle and L. G. Jones. 'S-Gravenhage, Mouton and Co., 1959, 1v. incl. illus. diagrs. tables, refs. (Description and Analysis of Contemporary Standard Russian Series I) (In cooperation with Harvard U., Cambridge, Mass.) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], Carnegie Foundation, National Science Foundation, and Rockefeller Foundation) Unclassified

It is necessary to state abstract conditions which define the theoretical entities of phonology and restrict their mode of operation so as to allow for simple and general descriptions of the relevant facts. These conditions are discussed at length and are in effect the theory of phonology that underlies the present work. The theory is further extended to include a possible measure of simplicity for phonological description. The body of the work consists of a detailed description of the phonological system of contemporary Russian and a report on the results of acoustical measurements performed on various linguistic entities. In a number of important respects in which it departs from procedures that enjoy almost universal acceptance among contemporary phonologists, the present description follows methods that are characteristic of the work of E. Sapir, in that the relation between the phonological representation and the phonetic facts is embodied in a set of rules which must be applied in a particular order, instead of being given by a list of allophones.

1815

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CLASSIFICATION DECISIONS IN PATTERN RECOGNITION, by G. S. Sebestyen. Apr. 25, 1960, 79p. incl. diagrs. table, refs. (Technical rept. no. 381) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 260232 Unclassified

The basic element in the solution of pattern-recognition is the requirement for the ability to recognize membership in classes. This report considers the automatic establishment of decision criteria for measuring membership in classes that are known only from a finite set of samples. Each sample is represented by a point in a suitable chosen, finite-dimensional vector space in which a class corresponds to a domain that contains its samples. Boundaries of the domain in the vector space can be expressed analytically with the aid of transformations that cluster samples of a class and separate classes from one another. From these geometrical notions, a generalized discriminant analysis is developed which, as the sample size goes to infinity, leads to decision-making that is consistent with the results of statistical decision theory. A number of special cases of varying complexity are worked out. These differ from one another partly in the manner in which the operation of clustering samples of a class and the separation of classes is formulated as a mathematical problem, and partly in the complexity of transformations of the vector space which is permitted during the solution of the problem. The assumptions and constraints of the theory are stated, practical considerations and some throughts on machine learning are discussed, and an illustrative example is given for the automatically learned recognition of spoken words. (Contractor's abstract)

1816

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MEASUREMENT OF FLUCTUATIONS IN RADIATION FROM A SOURCE IN THERMAL EQUILIBRIUM, by M. Harwit. June 1960 [106]p. incl. illus. diagrs. 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) Unclassified

The principal aim of this study is to measure the Bose-Einstein classical or beat frequency fluctuation in a stream of photons from a source in thermodynamic equilibrium, and thus to verify the Einstein-Fowler equation of statistical thermodynamics: $\overline{(\Delta E)^2} = kT^2 \frac{\partial E}{\partial T}$. By quantum statistical means, the fluctuation in the stream of radiation incident on a detector from a source at temperature, T, is determined. Further, the amount of cross-correlation expected for the output current of 2 detectors illuminated by this source is derived. It is shown that the measured cross-correlation depends on the source temperature and can be used as a measure of source temperature. Hanbury Brown, and Twiss's theory of the intensity interferometer, based on an electromagnetic formulation is reproduced. Their results are then compared to the quantum statistical results in the region of common applicability; the 2 theories are found to concur. It is shown that the infrared spectral region is inherently optimum for speed in intensity interferometry, but that a microwave maser system may be competitive with the best available infrared detectors. Photon fluctuation experimental results

show that the measured correlation value agrees with the value predicted by the Einstein-Fowler equation, within experimental error. The average signal-to-noise ration is 3.9. (Contractor's abstract, modified)

1817

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MIGRATION AND EFFECTS OF COPPER IN P-TYPE BISMUTH TELLURIDE, by O. P. Manley. Sept. 1, 1960, 35p. incl. illus. diagrs. tables, refs. (Technical rept. no. 376) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

The effects of copper on p-type Bi_2Te_3 were studied by examining the changes in resistivity and thermoelectric power induced in samples placed in intimate contact with copper. The experimental results were used to estimate the over-all change in the electrical transport parameters between the limits of no copper present and full compensation. Because of analytical difficulties, it was not possible to determine such changes for intermediate degrees of doping. Furthermore, the data for the regions in which the host lattice was overcompensated indicated that a chemical change was taking place; therefore, any interpretation of the experimental results in terms of simple doping did not seem plausible. The interpretation of these measurements allowed the activation energy for diffusion of Cu in the direction parallel to the cleavage planes to be measured; the results were found to be in agreement with those reported by others. (Contractor's abstract)

1818

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NEW METHODS IN METROLOGY. TRACING OF LARGE GRATING SYSTEMS WITH THE AID OF A MECHANICAL CARRIAGE CONTROLLED BY PHOTOELECTRIC INTERFEROMETRY, by G. W. Stroke. [1960] [33]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Air Force Cambridge Research Center; Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108; Army Research Office (Durham) and National Science Foundation) Unclassified

Published in Optics in Metrology; Colloq. of the Internat'l. Commission of Optics, Cambridge, Mass. (May 6-9, 1958), ed. by P. Mollet, New York, Pergamon Press, 1960, p. 38-118.

A report is made on the successful use of interferometric control techniques originated by Harrison (1949). While the most spectacular application of interferometric photoelectric servo control involves the ruling on the MIT ruling engine, of a number of 10 in gratings of unmatched quality, an important result of the efforts which led to this achievement is found in new insight into the problems of properly translating the actual motions of a mechanical carriage into representative interferometric information. This new knowledge is applied to a measurement of the velocity of light in terms of 2 primary atomic standards, for length and frequency, and to the ruling of still larger diffraction gratings. (Contractor's abstract)

1819

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

SURFACE-DOMINATED JUNCTIONS, by J. F. Campbell, Jr. [1960] [5]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 Report on the Twentieth Annual Conf. on Physical Electronics, Cambridge, Mass. (Mar. 24-26, 1960), Massachusetts Inst. of Tech., Cambridge, 1960, p. 116-120.

The voltage-current characteristics of diodes has been studied. For the diode tested, 63 v is the next point below breakdown at about 70v. From here, one progresses downward in voltage so that each current is approached from 2 directions in order to bracket the final current value. The present discussion is mainly concerned with the forward part of the characteristic. One may expect a surface layer to look electrically like a very lossy transmission line, with a series resistance per unit length formed by the resistance of the channel, with a leakage conductance per unit length formed by the conductance of the virtual p-n junction between the surface layer and the bulk, and with a capacitance formed by the space-charge layer of this junction. According to transmission line theory, the conductance of such a line is higher for ac than for dc. Therefore, one might expect to differentiate between channel and bulk effects by measuring the small-signal ac conductance of the diode for forward biases. This has been accomplished and the results are shown in graphic form. A simple theory has been devised for the expected dc behavior of a forward-biased channel. It must be stressed that the model and the conclusions are highly tentative, representing a partial analysis of the data from only one diode. However, the agreement with experiment is quite good and gives a consistent picture of the diode behavior.

1820

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANISOTROPY OF THERMOELECTRIC POWER IN BISMUTH TELLURIDE, by J. H. Dennis. Jan. 15, 1961, 52p. incl. illus. diagrs. table, refs. (Technical rept. no. 377) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Bismuth telluride (Bi_2Te_3) has a hexagonal close-packed structure and highly anisotropic electrical and thermal conductivity. However, its thermoelectric-power tensor is only anisotropic under 2 rather special conditions. It

is shown theoretically, on the basis of the transport theory for the many-valleyed model of the band structure of Bi_2Te_3, that one way in which the thermoelectric power of this material can be made anisotropic is by causing 2 scattering mechanism (lattice and impurity) to operate simultaneously in the material. Iodine-doped n-type material accordingly exhibits an anisotropy of thermoelectric power which is believed to be caused by this mixed scattering, whereas undoped p-type Bi_2Te_3 is found to have isotropic thermoelectric power for any temperature up to room temperature. The theory also predicts that the thermoelectric power can be made anisotropic if there is simultaneous conduction by holes and electrons. Thus, above room temperature, when intrinsic conduction is setting in, the thermoelectric power of undoped p-type material indeed becomes anisotropic. Single crystals of Bi_2Te_3 were grown in a crystal and thermoelectric puller, in both crystallographic directions, over a wide range of temperature. The results of these measurements were in agreement with the predictions of the theory. (Contractor's abstract)

1821

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CORRECTED ANALYSIS OF PLANE FINITE WAVES, by R. D. Fay. [1961] [3]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. Acoust. Soc. Amer., v. 34: 1269-1271, Sept. 1962.

This paper tries to correct errors in a previous paper. The method of attack is somewhat modified, a remarkably straightforward analysis yields an expression for the attenuation of repeated saw-tooth waves. The expression is in substantial agreement with those obtained by other methods. (Contractor's abstract, modified)

1822

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

OXYGEN TRANSPORT AND REACTION RATES AT AN AIR-DEPOLARIZED COPPER CATHODE, by H. C. Weber, H. P. Meissner, and D. A. Sama. [1961] [6]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Aeronautical Systems Division, Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Standard Oil of Indiana Foundation) Unclassified

Presented at meeting of the Electrochem. Soc., Detroit, Mich., Oct. 1-5, 1961.

Published in Jour. Electrochem. Soc., v. 109: 884-889, Oct. 1962.

Air-depolarized partially submerged electrodes were studied to determine the location of the zones of reaction and the rate-controlling steps in their operation. Reaction was found to occur primarily on that part of the surface of the electrodes covered by the electrolyte meniscus. The rate-controlling step was the diffusion of oxygen through the liquid meniscus to the electrode surface. The mass transport of oxygen as a rate-controlling step was eliminated in a specially constructed wiped, rotating, partially submerged copper electrode. This electrode was used to measure the oxidation rate of copper at room temperature for various partial pressures of oxygen. Oxidation rates were found to be great enough to support far larger current densities than are generally attainable in normal oxygen-electrode operation. The oxidation of copper was found to follow the logarithmic equation $w = k_1 \text{Log}(k_2 t + 1)$, where k_1 was independent of oxygen partial pressure, and k_2 was proportional to the square root of the oxygen partial pressure. (Contractor's abstract)

1823

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE ABSENCE OF CIRCULAR DICHROISM IN $^{16}O_2$ AND A RESULTANT UPPER LIMIT FOR PARITY NON-CONSERVATION, by L. C. Bradley, III and N. S. Wall. [1962] [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) Unclassified

Published in Nuovo Cimento, Series X, v. 25: 48-54, July 1, 1962.

By a study to determine the preferential absorption of one component of circularly polarized light in a molecular magnetic dipole transition in $^{16}O_2$, an upper limit to the parity impurity of the states involved in the transition has been determined. From a measurement of the circular polarization that is less than or equal to 6.10^{-4}, it is found that the amplitude of the PNC part of the states are less than or equal to 3.10^{-8}. (Contractor's abstract)

1824

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANALYSIS OF NASAL CONSONANTS, by O. Fujimura. [1962] [12]p. incl. illus. diagrs. table, refs. (AFCRL 63-180) (Sponsored jointly by Air Force Cambridge Research Labs., 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 Jour. Acoust. Soc. Amer., v. 34: 1865-1875, Dec. 1962.

The sound spectra of nasal murmurs in various vowel contexts have been studied by use of an analysis-by-synthesis scheme. The acoustic characteristics are

described in terms of formant-antiformant distributions (pole-zero locations of the transfer function for the articulatory system) in the frequency domain. It is shown that the location of the antiformant characterized the murmur of each consonant within the class. The spectral structures are discussed with reference to the articulatory features, and acoustical interpretations of the observed characteristics of the formants and antiformant are given. The existence of certain gross spectral features that are characteristic of nasals as a class is also suggested. (Contractor's abstract)

1825

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

APPLICATION OF STOCHASTIC APPROXIMATION METHODS TO SYSTEM OPTIMIZATION, by D. J. Sakrison. July 10, 1962, 74p. incl. diagrs. refs. (Technical rept. no. 391) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108)
AD 278633 Unclassified

Systems whose form is fixed but which contain a number of variable parameters are considered. The system input v(t), is a sample function from a stationary ergodic random process: corresponding to v(t) there is another ergodic random process, d(t), which represents the desired output for the system. The problem of interest is how to find the setting of the variable parameters which causes the actual system out, q(t), to resemble most closely the desired output, d(t). An iterative method of solution is the approach considered here. That is, a sequence of parameter settings is generated by selecting an initial setting and then alternately observing the system performance and altering the parameter setting. A particular iterative adjustment procedure is considered and it is proven that, for certain forms of systems and under certain reasonable conditions on the random processes, the sequence of parameter settings generated by the adjustment procedure does converge to the optimum setting in the mean square sense. (Contractor's abstract, modified)

1826

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN ATTEMPT TO MEASURE ZEEMAN SPLITTING OF THE GALACTIC 21-CM HYDROGEN LINE, by S. Weinreb. [1962] [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], and National Science Foundation)
Unclassified

Published in Astrophys. Jour., v. 136: 1149-1152, Nov. 1962.

An autocorrelation system analogous to a radiometer having several channels 7.5 kc/s in width, was used to measure the Zeeman effect on the deep narrow features of the Taus-A and Cas-A absorption spectra. It is concluded that the line of sight components of the magnetic field are less than 5×10^{-6}G and 3×10^{-6}G in the 2 features.

1827

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AUDITORY PATTERN-PROCESSING MODEL (Abstract), by S. Inomata. [1962] [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 Sixty-third meeting of the Amer. Acoust. Soc., New York, May 23-26, 1962.

Published in Jour. Acoust. Soc. Amer., v. 34: 739, May 1962.

An auditory pattern-processing model has been proposed in which an input auditory signal is roughly processed initially by a bank of low-pass filters. Each filter output is fed to a probabilistic coder whose output pulse probability is a function of the average energy of the positive portion of the input signal. The circuits have 3 different modes of conversion. A special feature of the model is that the place pattern analysis is done by a process similar to that of solving a Fredholm integral equation of the first kind, in which the kernel is related to the transmission characteristics of the low-pass filters. The spectrum reconstruction or spectral sharpening that can be achieved by this process is analogous in function to the sharpening observed in neurophysiological experiments. The time-pattern analysis, on the other hand, is carried out by periodicity-detecting methods. The relation of the model to psychoacoustical and neurophysiological data is discussed, and the implications of the model with regard to the specification of optimum speech-processing devices are considered. A programming method to implement the model on a digital computer is outlined.

1828

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

BEAM-PLASMA DISCHARGE (Abstract), by W. Getty, B. Hartenbaum and others. [1962] [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., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 169, Feb. 28, 1963.

The beam-plasma discharge is a low-pressure microwave discharge in which the microwave power is generated within the plasma by a collective interaction between a dense electron beam and the plasma. The interaction between the beam and plasma is such that intense microwave oscillations are produced either in the neighborhood of the electron-cyclotron frequency or

of ω_p of the plasma. The oscillations are associated with large oscillatory velocities of the plasma electrons. If these velocities are large enough, the electrons will further ionize the ambient gas, thus shifting ω_p and the oscillation frequency. In the experiments, it is observed that this ionization process occurs and that ω_p increases rapidly. Experiments are described in which a pulsed 10-kev, 1-A beam was injected along the axis of a magnetic mirror into a drift region containing gas (Ar, He, H_2) at 10^{-4}–10^{-3} mm Hg. Plasmas were produced with densities greater than 10^{12} cm^3, with electron "temperatures" in excess of 1000 ev, and ion temperatures of 5–10 ev.

1829

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

CALCULATION OF DISTRIBUTIONS IN ONE-DIMENSIONAL PLASMA SHEATHS, by D. J. Rose and R. J. Esterling. [1962] [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], and National Science Foundation)
Unclassified

Published in Jour. Appl. Phys., v. 33: 3317-3318, Nov. 1962.

In collisionless plasma acceleration and sheath problems, where the potential and one of the fluxes are known, the distribution in energy of flux of the other species can be computed as a solution of Abel's equation. This technique is illustrated, and self-consistent sample solutions are given for ion and electron beams crossing a potential drop, with a concomitant-trapped electron flux. (Contractor's abstract)

1830

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CALIBRATION OF AN ELECTROMAGNETIC VELOCITY PROBE FOR ELECTRICALLY CONDUCTING LIQUIDS, by G. B. Kliman. [1962] [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], and Flight Accessories Lab.)
Unclassified

Published in Rev. Scient. Instr., v. 33: 684-685, June 1962.

A miniature electromagnetic flowmeter which is suitable for studying the effects of magnetic fields on flowing electrically conducting liquids is described. Probe calibrations up to 140 cm sec are given and the limitations of the flowmeter are discussed.

1831

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

CLICK-EVOKED RESPONSES FROM ELECTRODES IMPLANTED IN CAT (Abstract), by D. C. Teas and N. Y.-S. Kiang. [1962] [1]p. (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)
Unclassified

Presented at Fall meeting of the Amer. Physiol. Soc., Buffalo U, N. Y., Aug. 28-31, 1962.

Published in The Physiologist, v. 6: 235, Nov. 1963.

At the cortex (AI) of the awake cat, the evoked response to an acoustic click shows an early (8 - 12 msec) surface-positive deflection, a second (22 - 29 msec) surface-positive deflection, and a later (60 - 80 msec) surface-negative deflection. The three deflections show different properties in relation to variation in stimulus parameters and variation in organismic parameters. The late deflection is labile and is absent when the electrocorticogram and the electromyogram neck muscles) indicate that the cat is not awake. In contrast the early deflection (8 - 12 msec), while less sensitive to change in organismic variables, can be manipulated by stimulus variables, in particular background noise. Thus the early and the late components can be selectively eliminated from the complex evoked response.

1832

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COMBINATION OF NOISE AND PURE-TONE MASKING (Abstract), by D. M. Green. [1962] [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 Sixty-third meeting of the Acoust. Soc. Amer., New York, May 23-26, 1962.

Published in Jour. Acoust. Soc. Amer., v. 34: 745, May 1962.

Consider a pulsed sinusoid of 1 10 sec duration partially masked by white noise. It is well known that the level of signal must be varied linearly with the level of the noise to maintain some constant degree of masking. That is, the degree of masking is constant if the signal-to-noise ratio is constant. A similar relationship holds for a pulsed tone masked by a continuous sinusoid of the same frequency. Suppose, in separate experiments, the level of noise and level of the continuous sinusoid are adjusted so that each has equal masking effectiveness on a signal of some given level. If now the noise and sine-wave masker are combined, how much must the level of the signal be increased in order to achieve the same level of masking effectiveness as before? Rather than

3 db or some lesser number, the increase appears to be somewhere between 6 and 9 db. Other experiments related to this phenomena are discussed.

1833

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COMIT: A LANGUAGE FOR SYMBOL MANIPULATION, by C. Bosche. [1962] [7]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 Symbolic Languages in Data Processing, Proc. of the Symposium, Rome (Italy) (Mar. 26-31, 1962), New York, Gordon and Breach, 1962, p. 113-119.

COMIT is a general-purpose symbol manipulation programming language which provides facility for pattern searches and transformations on symbolic elements held in lists. It is possible to write recursions with several COMIT rules and to represent complex structures of information in COMIT. Since there are several different logical parts to COMIT storage, information may be coded in several ways and programs of quite different types written to solve the same problem. Information may be held in constituents, order of constituents, subscripts, the dispatcher, the implicit flow of control, shelf order, etc.

1834

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COMMENTS ON "NOISE IN PHOTOELECTRIC MIXING", by H. A. Haus and C. H. Townes. [1962] [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 Proc. Inst. Radio Engineers, v. 50: 1544-1546, June 1962.

Comments are made on the signal-to-noise ratios of photoelectric heterodyne and homodyne converters. Similarities and differences between the two types of converter are discussed,and the connection between Oliver's treatment (Proc. IRE, v. 49: 1960-1961, Dec. 1961) and the principle of complementarity is pointed out.

1835

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A DECISION STRUCTURE FOR TEACHING MACHINES, by R. D. Smallwood. July 1962. 1v. incl. diagrs. tables, refs. (Special technical rept. no. 7) Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 287647 Unclassified

The purpose of this report is to present a possible decision structure that can be used by a teaching machine. Elements which constitute the structure within which the quantitative nature of the teaching machine operates are introduced. An evaluation of the performance of 2 estimation models on a set of actual responses by students to a teaching machine program is given. Finally, a description is presented of a preliminary teaching system that was constructed to illustrate how one could use the structure and tools in a specific device.

1836

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

DEPOLARIZATION OF Hg^{202} ATOMS IN THE METASTABLE 6^3P_2 STATE (Abstract), by B. B. Aubrey and L. C. Bradley, III. [1962] [1]p. (In cooperation with Yale U., New Haven, Conn.) (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. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 259, Apr. 23, 1962.

Hg atoms were excited to the metastable $6\,^3P_2$ state by unidirectional electrons in a planar diode containing natural Hg at a pressure of a few microns. The polarization in the $^3P_2$ state of Hg^{202} was determined by measuring the absorption of the vapor for polarized λ 5461 radiation from an Hg^{198} lamp in a scanning magnetic field. The mean times between quenching and depolarizing collisions, $T_0 = (5.5 \pm 2.0) \times 10^{-5}$ sec and $T_1 = (3.2 \pm 2.0) \times 10^{-5}$ sec, respectively, were determined for Hg^{202} metastables by letting argon into the diode and by measuring the quenching and depolarization of the Hg^{202} metastables as a function of the argon pressure. The value of T_1 yields a value of $(1.3 \pm 0.8) \times 10^{-14}$ cm^2 for the cross section for depolarization of the metastables by ground-state Hg atoms.

1837

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

DIFFUSION OF A FINITE CYLINDRICAL PLASMA IN A MAGNETIC FIELD (Abstract), by S. D. Rothleder and D. J. Rose. [1962] [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., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 149, Feb. 28, 1963.

Measurements were made, with Langmuir probes of the spatial distribution of plasma density, potential, electron temperature, and current density in a steady-state, magnetically confined, finite cylindrical plasma. The plasma, of density and percentage ionization greater than 10^{13} cc and 50%, respectively, was produced by a hollow-cathode discharge plasma source located on the axis of the cylinder. The measurements were made for magnetic fields in the range 300-1100 G, and for both insulating and conducting cylindrical end plates. Significant differences were found in the radial distributions of plasma properties for the 2 cases of insulating and conducting end plates, which were directly related to corresponding changes in the current-density distribution. The experimental results can be explained in terms of a steady-state, continuum plasma theory with classical collisional diffusion.

1838

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ELECTROHYDRODYNAMIC AMPLIFICATION (Abstract), by J. R. Melcher. [1962] [1]p. (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 meeting of the Amer. Phys. Soc., Northwestern U., Evanston, Ill., June 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 414, June 19, 1962.

The dynamics of conducting jets stressed by electric fields is considered theoretically and experimentally. At sufficiently high electric fields, jets of plane and circular cross section display a convective instability, if the jet velocity exceeds the effective phase velocity of a capillary surface wave. Interactions with external electrodes such as are used to introduce and extract electrical energy from the jet are considered. If a sinusoidal signal is introduced on the plane jet, it is amplified at the expense of the steady kinetic flow energy at a rate and over a frequency range that increase with the applied field intensity. If plane parallel electrodes interact strongly with the plane jet, this increase is directly proportional to the field. The circular jet behaves roughly in the same way, except that there may be a lower and an upper cutoff frequency that depend on the circular mode excited. A circular-jet experiment showed an upper cutoff frequency that agreed with the theory. The frequency range was 0-500 cps. The input capacitance is less than 10^{-12} F with a resistance limited by the insulation used.

1839

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EMISSION OF MICROWAVES FROM PLASMAS, by G. Bekefi. [1962] [17]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 National Science Foundation) Unclassified

Published in Engineering Aspects of Magnetohydrodynamics, Proc. of the Third Symposium, Rochester, N. Y. (Mar. 28-29, 1962), New York, Gordon and Breach, 1964, p. 7-23.

The results of 3 experiments made on plasmas with non-Maxwellian distributions are described. The first experiment was successful in the sense that the observations could be interpreted, and the mean electron energy and the distribution function could be estimated. The second and third experiments did not produce meaningful results.

1840

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

FOURIER COEFFICIENTS OF POWER-LAW DEVICES, by P. Penfield, Jr. [1962] [16]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 Ford Foundation) Unclassified

Published in Jour. Franklin Inst., v. 273: 107-122, Feb. 1962.

A definite integral often used in evaluating Fourier coefficients of power-law devices under sinusoidal excitation is:

$\frac{1}{2\pi}\int_0^{2\pi}(1+\epsilon\cos\omega t)^{\alpha}\cos n\omega t\,d(\omega t)$ where α is an exponent characteristic of the device, and ϵ is an amplitude factor. In many practical cases, this integral can be evaluated in closed form, and when it cannot, there is a rapidly converging series representation. This representation can be used to derive differentiation formulas and recursion relations, and is also ideally suited for numerical calculations. This representation is discussed; differentiation and recursion relations are given; and several of the closed-form solutions are listed. (Contractor's abstract, modified)

1841

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

FREQUENCY AND TEMPERATURE DEPENDENCE OF ULTRASONIC ATTENUATION IN LIQUID HELIUM BELOW 1°K (Abstract), by W. A. Jeffers, Jr. and

W. H. Whitney. [1962] [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 meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 472, Aug. 27, 1962.

The coefficient of absorption of sound in liquid helium has been measured at frequencies of 2.02, 3.91, 6.08, and 10.22 mc/sec at temperatures down to 0.2°K. Below 0.6°K, the attenuation varies approximately as $\omega^{1.5}T^3$. If the data are normalized to measurements of the absolute attenuation above 1°K, the attenuation below approximately 0.3°K appears to fall to zero more rapidly than T^3, in apparent agreement with the results of earlier experiments. However, if small corrections, consistent with the uncertainties in temperature measurement above 1°K, are made to the normalization constants, this change in temperature dependence can be made to disappear. It seems probable that the attenuation coefficient varies as $\omega^{1.5}T^3$ from 0.6°K down to the lowest temperatures reached. Above 0.6°K, the curves at the lower frequencies rise more rapidly than T^3 up to the peak of the absorption curve.

1842

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

FUNCTIONAL ANALYSIS APPLIED TO NONLINEAR FEEDBACK SYSTEMS, by G. Zames. [1962] [13]p. incl. diagrs. refs. (In cooperation with Harvard U., Cambridge, Mass.) (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-186616) Unclassified

Published in I. E. E. E. Trans. on Circuit Theory, v. CT-10: 392-404, Sept. 1963.

An operator theory is outlined for the general, nonlinear, feedback loop. Methods for bounding system responses and investigating stability are introduced. An iterative expansion of the feedback loop, valid for large nonlinearities and unstable systems, is derived. The theory is applied to the study of nonlinear distortion in a class of amplifiers; it is shown that feedback reduces distortion for band-limited inputs. A model of stable distortion is obtained and an iteration with optimized rate of convergence, is derived. (Contractor's abstract)

1843

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A FUNDAMENTAL COMPLEMENTARY PRINCIPLE FOR INDUCTIVE LOGIC, by M. C. Goodall. [1962] [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 Nature, v. 194: 998, June 9, 1962.

A is to be taken as an interrogation (or selective punctuation) of U, the response S of which is a string leading from A to a true sentence $\bar{S}$ in some L. A formalism may be set up in which $L(S, \bar{S})$ plays the part of a Lagrangian function. The formalism is analogous to the many-particle theory because $L(S, \bar{S})$ must always contain the results of indefinitely many other punctuations. The principal interest of this formalism is that it is appropriate to investigating the relation between an evolutionary system such as O and its environment U.

1844

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

GENERATION OF A HOT, DENSE PLASMA BY A COLLECTIVE BEAM-PLASMA INTERACTION, by L. D. Smullin and W. D. Getty. [1962] [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], and National Science Foundation) Unclassified

Published in Phys. Rev. Ltrs., v. 9: 3-6, July 1, 1962.

A pulsed 10 kev 1A electron beam is projected into a drift region and confined by an axial magnetic field of 200-1000 gauss. The various quantities observed are the instantaneous currents to the wall, anode and collector; the response of a photomultiplier pointed at the path of the beam; the video output of a tuneable microwave receiver and x radiation. It is shown that the collector current reaches a peak and remains constant for the first 1.5 μ sec of a pulse and then breaks up, the missing current appearing as wall current. Sometime after this break strong oscillations are detected, from the frequency of which the electron density is computed.

1845

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

GROWING HELICAL DENSITY WAVES IN SEMICONDUCTOR PLASMAS, by C. E. Hurwitz and A. L. McWhorter. [1962] [3]p. incl. diagr. 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. Ltrs., v. 10: 20-22. Jan. 1, 1963.

Theory and experiments are described using high quality germanium filaments. The observed effect of spatially growing screw-shaped waves shows up in the form of a unidirectional traveling-wave amplification.

1846

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INSTABILITIES OF A LIQUID CONDUCTOR, by U. Ingard and D. S. Wiley. [1962] [3]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 Phys. Fluids, v. 5: 1500-1502, Dec. 1962.

Observations of pinch and spiral instabilities of a liquid conductor falling in an axial magnetic field are reported. Measured rates of change of the stream diameter and the spiral radius are given, and a stream bifurcation phenomenon that was induced by spiral instability is described.

1847

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

INTERACTION BETWEEN COLD PLASMAS AND GUIDED ELECTROMAGNETIC WAVES, II, by L. Mower and S. J. Buchsbaum. [1962] [7]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) Unclassified

Published in Phys. Fluids, v. 5: 1545-1551, Dec. 1962.

The interaction between cylindrically symmetric anisotropic plasma column and bounded electromagnetic waves is analyzed theoretically. The properties of a cylindrical cavity coaxial with a cold plasma column and a coaxial with a static magnetic field are determined. The shift in the resonant frequency of the cavity-plasma system is calculated in the high-electron-density limit and compared with the numerical solution presented earlier. (Contractor's abstract)

1848

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

INTERACTION OF A DIRECTED PLASMA WITH A MAGNETIC MIRROR (Abstract), by L. M. Lidsky and D. J. Rose. [1962] [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., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 162, Feb. 28, 1963.

The interaction between a directed plasma and a "magnetic barrier" was investigated using a stationary plasma column and a moving magnetic field. This scheme has the advantage that the plasma properties are better known. The plasma (He or Ar), supplied by a modified hollow-cathode source, had density of up to $10^{13}/cm^3$ and was 75%-95% ionized. The magnetic field, generated by a pulsed, capacitively loaded helical line, had a translational velocity 1.5×10^7 cm/μ sec with peak field 4000 G. Titanate ceramic formed the dielectric element. A correction for the important but often overlooked effect of inductive coupling was derived. The experiments showed no evidence of ion reflection from the moving barrier. A large number of high-energy (> 200 ev) electrons was generated during passage of the pulse. These are attributed to nonadiabatic reversed-field heating of electrons trapped in a positive space-charge-potential region at the position of the field peak.

1849

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

INTERFEROMETRIC METHOD OF VELOCITY OF LIGHT MEASUREMENT, by G. W. Stroke. [1962] [6]p. incl. illus. 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 Appl. Opt., v. 2: 481-486, May 1963.

An association of interferometric methods in the 3.2-cm microwave and visible-light optical domains is now being used for the measurement of the velocity of light in terms of primary atomic constants, an atomic clock for the frequency and a light source (Hg 198, Kr 86, optical maser) for the length. The microwave interferometry is carried out by hydraulically and continuously moving a piston in a perfect silver-plated, optically polished, fused-quartz, cylindrical resonant cavity. The optical and mechanical systems involve several novel features extending the interferometric servo-control method using photoelectric detection successfully applied to the ruling of high-resolution gratings. With precisions as good or better than those obtained in any previous measurement of c, an increase in accuracy by 1 to 3 orders of magnitude results from the use of primary standards for the frequency and length rather than the unreliable secondary standards used heretofore. This fact applies to other velocity-of-light measurements as well and should help in reducing the rather disturbing dispersion in the values of c, which heretofore considerably exceeded the precisions obtained in the measurements. (Contractor's abstract)

1850

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

I. IONIZATION OF CESIUM AT SURFACES. II. THE ENERGY DISTRIBUTION FOR ELECTRONS IN A THERMIONIC DIODE PLASMA CANNOT BE TRULY MAXWELLIAN, by W. B. Nottingham. Aug. 17, 1962, 25p. incl. diagrs. tables. (Technical rept. no. 405) (Sponsored jointly by Air Force Office of Scientific

Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 234489
Unclassified

Part I published in Advanced Energy Conversion, v. 3: 245-253, 1963.

Part II published in Advanced Energy Conversion, v. 2: 467-479, 1962. (AFOSR-J1119; AD 403611)

In Part I, experiments have been conducted to study ionization quantitatively for a low Cs concentration. Electrons were accelerated from heated surfaces E2 and E3 bombard E1. Ions produced at or near E1 were then accelerated toward the ion collector to serve as a measure of the ion production. Results of this experiment indicate that no appreciable ion current was produced in Cs vapor controlled by a $T_{Cs} = 350°K$, by electrons having an energy less than 3.89 volts. The square root of the ion-to-electron current ratio was a linear function of the surface electron energy in excess of the ionization potential. Although not accurately determined, the ionization coefficient is given by $P_i = P_1 (V-V_1)$ with $P_1 = 20\ cm^{-1}v^{-1}$ for the standard conditions of 3.54×10^{16} atoms/cm^3. In Part II, the energy distribution of electrons is studied. For refractory emitters, such as W, Ta, and Mo, operated in an energy-conversion diode, the ratio of the emitter temperature to the Cs temperature strongly influences the operating properties. If this ratio exceeds 3.2, an ion-rich sheath usually forms at the emitter surface; electrons are accelerated in the plasma space by this injection potential. An analysis shows that at the open-circuit condition, the energy distribution of the electrons at the plasma edge of the emitter sheath cannot be a true Maxwellian over the entire range in electron energy; instead, it is thought to be made up of 2 quasi-Maxwellians. The low energy electrons are trapped and may have a high average energy close to that of the injection potential. The untrapped electrons will have a. electron temperature equal to that of the emitter and their density will be that associated with an apparent or ficticious density many times that of the actual density. A theory has been developed to describe quantitatively the relations that must be satisfied for the description above to apply. It is concluded that if the emitter-to-Cs temperature ratio exceeds 3.6, volume ionization is not required for a stable sheath. In the range 3.2-3.6, surface ionization is usually insufficient, and it is necessary to have volume ionization to sustain the sheath. (Contractor's abstract, modified)

1851

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A KINETIC STUDY OF GLUTAMIC-ASPARTIC TRANSAMINASE, by G. G. Hammes and P. Fasella. [1962] [7]p. incl. illus. 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 National Institutes of Health)
Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 4644-4650, Dec. 20, 1962.

Kinetic studies of glutamic-aspartic transaminase have been made at high enzyme concentrations (10^{-5} M) using the temperature jump method. The observed relaxation times ranged from less than 50 μsec to about 20 msec. The minimal mechanism consistent with spectral and kinetic data is $E_L + As = X_1 = X_2 = E_M + Oa$ (1) $E_M + Kg = Y_2 = Y_1 = E_L + Gm$ (2). Here E_L is the aldehydic form of the enzyme, E_M is the aminic form, Gm, Kg, Oa and As are the substrates glutamate, ketoglutarate, oxalacetate and aspartate, respectively, and the X's and Y's are enzyme-substrate intermediates. Individual rate constants or lower bounds thereof were obtained for all of the steps: in addition approximate spectra were found for the intermediates which are consistent with their being Schiff bases. The binding constants for Schiff base formation are quite high—10^3 to $10^5\ M^{-1}$ depending on the specific substrate. The measured bimolecular rate constants for the interconversion of intermediates are between 10 and $10^2\ sec^{-1}$. These results are also in accord with stopped-flow and equilibrium dialysis experiments. (Contractor's abstract)

1852

Massachusette Inst. of Tech. [Research Lab. of Electronics] Cambridge.

KINETIC THEORY OF PLASMA AND ELECTROMAGNETIC FIELD (Abstract), by T. H. Dupree. [1962] [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 meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v.8: 151, Feb. 28, 1963.

By generalizing a method due to Klimontovich, it has been possible to derive a closed set of equations for plasma and electromagnetic fields. These equations determine the particle distribution functions and ensemble-averaged fields as well as a complete set of correlation functions involving particle and field fluctuations. The equations are not limited to steady-state or uniform plasmas. It is shown that, in general, a correlation exists between all field components even though there is no direct interaction between fields. Solutions for all correlation functions have been obtained and are valid for small departures from the steady state. These correlation functions have been used to obtain formulas for electromagnetic energy density, incoherent scattering, and a generalized collision integral.

1853

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LISP 1.5 PROGRAMMER'S MANUAL, by J. McCarthy, P. W. Abrahams and others. Aug. 17, 1962, 99p. 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, National Institutes of Health, and National Science Foundation) AD 406138 Unclassified

The LISP language is designed primarily for symbolic data processing. It has been used for symbolic calculations in differential and integral calculus, electrical circuit theory, mathematical logic, game playing, and other fields of artificial intelligence. LISP is a formal mathematical language; it is therefore possible to give a concise yet complete description of it. Such is the purpose of the first section of the manual. Other sections describe ways of using LISP to advantage and explain extensions of the language which make it a convenient programming system.

1854

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE LOGICAL BASIS OF LINGUISTIC THEORY, by N. Chomsky. [1962] [95]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 Science Foundation) Unclassified

Published in Proc. Ninth Internat'l. Cong. of Linguists, Cambridge, Mass. (Aug. 27-31, 1962), ed. by H. G. Lunt. The Hague (Netherlands), Mouton and Co., 1964, p. 914-1008.

In this paper the term linguistic theory is restricted to systems of hypotheses concerning the general features of human language put forth in an attempt to account for a certain range of linguistic phenomena. Various levels of success may be attained by a grammatical description associated with a particular linguistic theory. The lowest level of success is achieved if the grammar presents the observed primary data correctly. A second and higher level of success is achieved when the grammar gives a correct account of the linguistic intuition of the native speaker, and specifies the observed data in terms of significant generalizations that express underlying regularities in the language. A third and still higher level of success is achieved when the associated linguistic theory provides a general basis for selecting a grammar that achieves the second level of success. In this case, we can say that the linguistic theory in question suggests an explanation for the linguistic intuition of the native speaker. Roughly stated these levels may be referred to as observational, descriptive, and explanatory adequacies. Several examples are given of how a higher level of adequacy might be achieved by linguistic theory in the domains of phonology and syntax. A concern with perception and acquisition of language has played a significant role in determining the course of development of linguistic theory. This report tries to show that the basic point of view regarding both perception and acquisition has been much too particularistic and concrete. It has failed totally to come to grips with the creative aspect of language use, that is the ability to form and understand previously unheard sentences.

1855

[Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.]

LOSS IN INFORMATION TRANSMISSION THROUGH TWO-WAY CHANNELS, by F. Jelinek. [1962] [35]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 Inform. and Control, v. 6: 337-371, Dec. 1963.

A discrete 2-way channel related to the pioneering work of C. E. Shannon (see item no. 1493, Vol. IV) and further developed by R. M. Fano (see item no. 1427, Vol. IV) is considered. Certain restrictions are put on the probability. The terminals are connected to finite-memory stationary signal sources. These signal sources generate channel inputs depending on sequences of past outputs and inputs. Expressions for average information transmission rates in the left-to-right and right-to-left directions can be developed and their sum will be a simple information measure. When mutually independent messages are to be transmitted in opposite directions through the channel, it is desirable that they be encoded into sequences of strategy functions which, together with the received signals, constitute inputs to a transducer whose outputs are the channel input signals. The message source encoder-transducer combinations are stochastically equivalent to signal sources whose outputs are governed by appropriate probabilities. We can interpret the transducer-channel combination as a derived 2-way channel whose inputs are the strategy functions and whose outputs are the outputs of the underlying channel. Expressions for the information transmission rate through the 2 directions of the derived channel are developed and are compared to the expressions for the average information about outputs of the equivalent signal sources, transmitted through the underlying 2-way channel. The values of the former expressions are found to be less than or equal to the values of the latter, the difference constituting a 'coding information loss'. A condition on the transmission probabilities permits a class of lossless channels to be defined. Similarly, another class is defined having the property that, regardless of the strategy code used, the information transmitted through the derived channel will be strictly less than the information transmitted through the underlying channel. The consequences of the above results on the random selection of message codes are discussed. It is shown that one can obtain the number of variables to be optimized when best random codes for lossy channels are desired, by using the number of variables for lossless channels as an exponent to the product of the size of the input and output signal alphabets. For the lossy channel class a simplified encoding procedure must in practice be applied, but as can be demonstrated, it will not yield optimal codes. (Math. Rev. abstract)

1856

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LOW RESONANT-FREQUENCY BARIUM-TITANATE TRANSDUCER, by L. W. Dean, III and N. A. Ball. [1962] [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])
Unclassified

Published in Jour. Accust. Soc. Amer., v. 34: 347, Mar. 1962.

A transducer consisting of a barium-titanate bilaminate-strip mass loaded at the ends was found to have a resonant frequency in the range 200-1700 cps. Comments are made on some of the electrical and mechanical parameters of this composite transducer. (Contractor's abstract)

1857

Massachusetts Inst. of Tech. Research Lab. of Electronics. Cambridge.

THE MAGNETOHYDRODYNAMIC FLOW PAST A NONCONDUCTING FLAT PLATE IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD, by D. M. Dix. Doctoral thesis, July 9, 1962, 128p. incl. diagrs. tables. refs. (Technical rept. no. 397) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108; Dept. of the Army, and National Science Foundation)
AD 278682 Unclassified

Also published in Jour. Fluid Mech., v. 15: 449-476, Mar. 1963.

The general character of the magnetohydrodynamic flow past a non-conducting flat plate in the presence of transverse magnetic fields is analyzed in some detail. The appropriate extension of the Rayleigh problem to the magnetohydrodynamic case is shown to yield solutions which correctly predict some features of the steady flow past a semi-infinite flat plate; in addition, it is shown that the knowlege of these significant features permits an easy evaluation of their magnitudes in other extensions of the Rayleigh problem. The flow past a semi-infinite flat plate is analyzed by 2 methods. First, by linearizing the governing equations and incorporating the assumption of a low ratio of viscous to magnetic diffusivity, the results for skin friction and the normal component of magnetic field at the plate are obtained, and are shown to be useful in interpreting the character of these low conductivity flows. Secondly, the complete set of governing equations is formulated as a finite difference problem and solved numerically on a digital computer. The results obtained, in addition to demonstrating feasibility of the numerical calculations, show that the disturbance produced by the plate is no longer confined to a thin viscous layer if the ratio of viscous to magnetic diffusivity is greater than 10^{-2}, but that an appreciable Alfvén type disturbance is excited. (Contractor's abstract)

1858

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

METHOD AND MERIT OF BINARY CODING FOR ANALOG CHANNELS, by I. M. Jacobs. [1962] [9]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 Proc. Nat'l. Electronics Conf., v. 18: 765-773, Oct. 1962.

Current engineering practice for achieving a low bit error probability in a binary transmission system is to utilize pulses with a duration sufficient to insure the required receiver-signal selection. This practice is identical to obtaining a reliable pulse by repeating each information bit a fixed number of times. Although optimum for the transmission of a single information bit, such repetition is inefficient for the transmission of a sequence of bits. The selection of more efficient signals is called coding. The reception of coded signals is conveniently considered as 2 steps, detection and decoding, the first largely analog and the second largely digital. For each pulse input, the detector produces an output number quantized into Q levels. After obtaining the detector output for a block of symbols, the decoder makes the final decision as to the transmitted binary sequence. In this paper, consideration is given to the improvement in rate and signal-to-noise ratio offered by coding and decoding for 3 values of detector quantization. Q = 2 (binary detection) Q = 3 (ternary or null-zone detection), and Q = ∞ (continuous or unquantized detection). A qualitative insight is then provided into convolutional encoding and sequential decoding as one means, adaptable to any value of Q, for realizing these gains.

1859

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MICROWAVE EMISSION AND ABSORPTION AT CYCLOTRON HARMONICS OF A WARM PLASMA, by G. Bekefi, J. D. Coccoli and others. [1962] [4]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78106], and Atomic Energy Commission)
Unclassified

Published in Phys. Rev. Ltrs., v. 9: 6-9, July 1, 1962.

Measurements on microwave emission and absorption are presented where the plasma frequency is of the order of, or greater than, the microwave radian frequency. The measured magnitudes and spectra of the emitted and absorbed radiation were found to differ greatly from those predicted theoretically. The magnitudes of the emission and absorption lines of the electron cyclotron harmonics were several orders of magnitude greater than those calculated for a warm plasma with a Maxwellian distribution of electron velocities.

Also, the line shapes were not Lorentzian. These phenomena were observed in weakly and highly ionized plasmas of low and intermediate gas pressures.

1860

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MICROWAVE EMISSION FROM NON-MAXWELLIAN PLASMAS, by H. Fields, G. Bekefi, and S. C. Brown [1962] [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-78108], and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 129: 506-515, Jan. 5, 1963.

Microwave measurements of the radiation from a weakly ionized low-energy plasma immersed in a magnetic field show significant departures from the Kirchhoff-Planck law. The departures can be explained by taking account of the non-Maxwellian distribution of the radiating electrons. By comparing the measured and calculated radiation temperatures we estimate the distribution of electron velocities and their mean energy.

1861

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MILLIMETRE-WAVE RADIO SOURCE IN TAURUS, by A. H. Barrett. [1962] [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) Unclassified

Published in Nature, v. 194: 170-171, Apr. 14, 1962.

Observations made at 1.8 cm wavelength give an upper limit to the flux density of a possible unusual radio source located 9 min of arc east of Taurus-A, which was observed by other workers at 8 mm. The results do not confirm the presence of such a source.

1862

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MINIMALLY REDUNDANT RELIABLE COMPUTING SYTEMS DESIGN (Abstract), by S. Winograd and J. D. Cowan. [1962] [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 Redundancy Techniques for Computing Systems, Proc. of the Symposium, Washington, D. C. (Feb. 6-7, 1962), ed. by R. H. Wilcox and W. C. Mann. Washington, Spartan Books, 1962, p. 377.

It can be demonstrated that redundant computers that achieve arbitrarily low frequencies of error (apart from errors in the final outputs), may be constructed, so that they are not completely redundant, but process a finite fraction of information. This depends critically upon the error behavior of components as a function of complexity. If component errors increase with complexity, the above reliability may be obtained only by decreasing the fraction of information processed in the computer. However, it appears likely that for given hardware and codes, this fraction can be maximized. A further result of interest, is that such computers need not be precisely connected and in fact a certain bounded fraction of errors in connection may be tolerated.

1863

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MOHAWK PREFIX GENERATION, by P. M. Postal. [1962] [12]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

Published in Proc. Ninth Internat'l. Cong. of Linguists, Cambridge, Mass. (Aug. 27-31, 1962), ed. by H. G. Lunt. The Hague (Netherlands), Mouton and Co., 1964 p. 346-357.

Modern descriptive studies of Northern Iroquoian, like similar grammatical studies of other languages, have centered attention on what is called segmentive analyses of sentences and their parts. The aim of the present paper is to show that an adequate description of Mohawk sentences is incompatible with this kind of analysis, since a valid theory of Mohawk sentences requires a much more abstract conception of linguistic structure which includes constituents only indirectly related to phonetics and the notion of ormal relations between sentence structures. The primary interest is in the pronominal prefixes of Mohawk verbs.

1864

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A NEW CANONIC REALIZATION PROCEDURE, by H. B. Lee. [1962] [5]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. E. E. E. Trans. on Circuit Theory, v. CT-10: 81-85, Mar. 1963.

A dual pair of new canonic cycles are presented. Each cycle develops an initial LC impedance into a nonsymmetrical lattice, terminated in a simpler LC impedance. The remainder impedance always has the same zero and infinite frequency behavior as the initial impedance but involves 4 fewer coefficients. The most complicated mathematical operation which must be performed to

execute either cycle is the factorization o. a second-degree polynomial. Both cycles are easily extended to the RC and RL cases. (Contractor's abstract)

1865

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR ISOMER SHIFT IN THE OPTICAL SPECTRUM OF Hg^{195}: INTERPRETATION OF THE ODD-EVEN STAGGERING EFFECT IN ISOTOPE SHIFT, by W. J. Tomlinson, III, and H. H. Stroke. [1962] [3]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 Atomic Energy Commission) Unclassified

Published in Phys. Rev. Ltrs., v. 8: 436-438, June 1, 1962.

For transitions involving electrons which penetrate the nucleus, the spectral lines are sensitive to the variations of the nuclear charge distribution arising from changes in neutron number. Data on the Hg isotope shifts of the 2537A line are collected and analysed. It is concluded that a possible basis for the odd-even staggering effect is that the odd neutron may go into a lower angular momentum orbit than the neutron pair and that in this orbit it is less effective in producing distortions.

1866

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

NUCLEAR MOMENTS AND ISOTOPE SHIFTS OF NEUTRON-DEFICIENT MERCURY ISOTOPES 195, 195^*, AND 194 (Abstract), by W. J. Tomlinson, III, and H. H. Stroke. [1962] [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. 23-26, 1962

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 300, Apr. 23, 1962.

An optical spectroscopic study has been made of Hg^{195} (9.5 hr), Hg^{195*} (40 hr) and Hg^{194} (~ 130d) using a 10-i.. grating in a 36-ft focal-length mirror monochromator. The isotopes were produced by $Au(p, xn)Hg^{198-x}$ reactions with 30-mev protons at the Harvard cyclotron. Spins of 13/2 and 1/2 for Hg^{195*} and Hg^{195}, respectively, are consistent with our data, whereas the previously suggested spin $I(Hg^{195}) = 3/2$ disagrees with our findings. With these values for the spins, the following moments were obtained from the measured hfs intervals: $u(Hg^{195}) = +0.53 \pm 0.05$ nm, $u(Hg^{195*}) = -1.05 \pm 0.05$ nm, $Q(Hg^{195*}) = (1.4 \pm 1.2) \times 10^{-24}$ cm^2. The signs of the quadrupole interaction constants are the same in Hg^{195*} and Hg^{201}. The isotope-shift measurements show an extension of the range of regularity in the shifts of the even-neutron isotopes to Hg^{194}, and provide further data for the study of odd-even staggering effects.

1867

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

NUCLEAR ORIENTATION AND MAGNETIC MOMENT OF Hg^{197} (Abstract), by W. T. Walter. [1962] [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. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 295, Apr. 23, 1962.

Optical pumping was used to orient both $I = \frac{1}{2}$ nuclei Hg^{197} and Hg^{199} in the ground state. An Hg^{202} lamp inside the air gap of a Bitter solenoid produced the circularly polarized pumping light. This variable-frequency light source is tuned by means of Zeeman shifting to pump either isotope. A single quartz cell was filled with stable isotope Hg^{199} and the 65-hr radio isotope Hg^{197}, and was placed in a homogeneous Helmholtz-field. Nuclear magnetic resonance in the oriented vapor of each isotope was optically detected in light scattered from the cell. Radio frequency 0.2-cps modulation and lock-in detection were employed. Resonances 25 cps wide were observed at 933 and 859 kc. The measured ratio was $u_{197}/u_{199} = 1.042479 (\pm 15)$. Comparison with the ratio of Stager's values of the interaction constants for the $^3P_1$ state, $A_{197}/A_{199} = 1.043284 (\pm 1)$, indicates a hyperfine-structure anomaly of 0.772 (± 14) parts in 1000. Using the Cagnac Hg^{199} result, $\nu_{197}/\nu_H = 0.185843^4 (\pm 30)$ and $u_{197} = 0.519014 (\pm 14)\mu_N$ without diamagnetic correction, is obtained.

1868

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON E. L. CHU'S DEFINITION OF SMALL-SIGNAL rf POWER OF ELECTRON BEAMS, by D. L. Bobroff, H. A. Haus, and J. W. Klüver. [1962] [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 Jour. Appl. Phys., v. 32: 749-750. Apr. 1961.

A reply to Chu's criticism of the authors' small-signal power theorem is presented. The value of the theorem in 2 problems is pointed out. In addition, flaws in Chu's treatment of the boundary condition are shown. It is concluded that his criticisms based on that treatment are not valid.

1869

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON THE LEARNING OF SPEECHLIKE VOCABULARIES, by A. S. House, K. N. Stevens and others. [1962] [11]p. incl. illus. 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 National Science Foundation) Unclassified

Published in Jour. Verbal Learning and Verbal Behavior, v. 1: 133-143, Sept. 1962.

A series of experiments dealing with the learning of ensembles of speechlike acoustic stimuli was performed. The stimulus ensembles differed with respect to the number of physical dimensions that were manipulated in generating the stimuli, and with respect to the extent to which the stimuli resembled speech. Results show that performance during learning is better when each stimulus is encoded into several physical dimensions than when the stimuli lie along a unidimensional continuum. Furthermore, as the stimuli become more like speech there is a deterioration of performance during learning, with the exception that performance is best when the stimuli are actually speech signals. Implications for theories of speech perception are discussed.

1870

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

OPTICAL ECHOES FROM THE MOON, by L. D. Smullin and G. Fiocco. [1962] [1]p. incl. 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 Nature, v. 194: 1267, June 30, 1962.

Using a ruby optical maser radiating 50 joule pulses, each of 0.5 msec duration, identifiable echoes were received in 4 different lunar regions on 3 successive nights, May 9-11, 1962. The optical system of the transmitter incorporated a Cassegrain reflector of 12-in. in diam, the reflected radiation was collected by a 48-in. Cassegrain reflector. The incoming signals were first passed through a 7A band-pass interference filter, and then detected by a photomultiplier unit cooled in liquid nitrogen.

1871

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A PHASE-COMPARATOR MODEL FOR THE DIURNAL RHYTHM OF EMERGENCE OF DROSOPHILA, by J. S. Barlow. [1962] [18]p. incl. diagrs. refs. (In cooperation with Massachusetts General Hospital, Boston) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], Charles E. Merrill Trust, National Institutes of Health, and National Science Foundation) Unclassified

Published in Ann. New York Acad. Sci., v. 98: 788-805, Oct. 30, 1962.

A model for the eclosion rhythm of Drosophila is proposed as a step in the consideration of more refined schemes of this example of biological clocks. It is similar in principle to the coupled-oscillator model of Pittendrigh and Bruce, in that it includes a primary oscillating system that is influenced greatly by light, but only slightly by temperature. The latter is postulated to have its major effect on a phase-comparator, the output of which in turn times the observed biological phenomenon. Effects of single light signals, temperature steps, and of combined light and temperature entrainment are illustrated with electronic mock-up or simulation experiments, and these are compared with the corresponding experimental data for Drosophila.

1872

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE PHYSICAL MEANING OF COMPACTNESS, by H. B. Lee. [1962] [7]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. E. E. E. Trans. on Circuit Theory, v. CT-10: 255-261, June 1963.

A lossless twoport N, whose impedances z_{11}, z_{12}, and z_{22} possess poles at the complex frequencies $s = \pm j\omega_p$, is considered. It is shown that the algebraic alternatives of compactness, or lack of compactness, for the z_{ij} at $s = \pm j\omega_p$ correspond directly to the physical alternatives of whether or not a pair of N's natural oscillations at the frequency $\omega = \omega_p$ are scaled replicas of one another throughout N. A secondary result of the paper is called the energy theorem. This theorem assumes that the natural oscillations of a lossless oneport have been excited by a unit impulse of current, and states that each impedance residue of the oneport is proportional to the energy stored in the corresponding one of these oscillations. (Contractor's abstract)

1873

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROJECT LUNA SEE, by L. D. Smullin and G. Fiocco. [1962] [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 Proc. Inst. Radio Engineers, v. 50: 1703-1704, July 1962.

The performance, apparatus and experimental results of a project to examine the possibilities of optical maser radar using the moon as a target are described. The transmitter used a 12-in. reflector with 50 J of pulse power (pulse width 1/2 msec); the receiver was a 48-in. reflector feeding a liquid-nitrogen-cooled photomultiplier via a 7 A wide interference filter. A signal-to-noise ratio of 0.5 was predicted, but the experimental results indicated an average significantly greater than this during the period when echoes were expected.

1874

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROTON MAGNETIC RESONANCE SPECTRA OF TETRAVINYL-SILICON, METHYL- AND ETHYL-VINYLKETONE, by S. C. Castellano and J. S. Waugh. [1962] [5]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], and National Institutes of Health) AD 403609 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1951-1955, Nov. 1, 1962.

NMR spectra of tetravinylsilicon, methyl-, and ethylvinylketone have been analyzed. The parameters found do not agree with those previously reported for the same compounds by other authors, although the source of several experimental data is the same; the coupling constants agree well with values already known for other vinyl compounds and correlate satisfactorily with the electronegativities of the elements bonded to the vinyl group. (Contractor's abstract)

1875

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROTON RESONANCE IN SOLID METHANE AT 4°K (Abstract), by W. M. Whitney, A. H. Dammig and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 226, Mar. 26, 1962.

A preliminary study has been made of the proton-resonance-absorption line in solid methane (CH_4) and in solid monodeuterated methane (CH_3D) at a temperature of 4.2°K and a frequency of 18 mc sec. Linewidths of 7.1 gauss and 5.4 gauss were obtained for CH_4 and CH_3D, respectively, and second moments of 7.1 and 5.5 gauss. From measurements made in mixtures of CH_4 with krypton, it is concluded that the intramolecular contribution to the second moment is small and probably zero. The results are discussed in relation to the theoretical calculation of the line shape by Tomita.

1876

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A QUANTITATIVE VIEW OF NEUROELECTRIC EVENTS IN RELATION TO SENSORY COMMUNICATION, by W. S. Rosenblith and E. B. Vidale. [1962] [46]p. incl. illus. 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 Psychology: A Study of a Science, Volume 4. Biologically Oriented Fields: Their Place in Psychology and in Biological Science, ed. by S. Koch, New York, McGraw-Hill, 1962, p. 334-379.

The important aspects of neural functioning seem to be represented by more or less complicated spatiotemporal patterns of neuroelectric activity and are not merely given by absolute values of electrical changes as a function of time. This concept of neuroelectric spatiotemporal patterning is designated by the abbreviation NSTP. The notion of a patterning of neural events that occur at one or more places in the nervous system and that typically have different temporal characteristics is by no means a novel one; similar ideas have been expressed by others. Nevertheless, this viewpoint is recapitulated in this paper since too many accounts of nervous-system functioning fail to deal with neural patterns. This emphasis upon the relational aspects of stimulus and of response variables is both conceptually and pragmatically useful, since it provides one with a strategic orientation in the task of ordering and relating the innumerable data that can be recorded from the nervous system. NSTP may prove to be an indispensable element in the formulation of neural correlates of behavioral events.

1877

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RECENT DEVELOPMENT IN OPTICAL CHARACTER RECOGNITION AT M.I.T., by L. G. Roberts. [1962] [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 National Institutes of Health) Unclassified

Published in Optical Character Recognition; Proc. of the Symposium, Washington, D. C. (Jan. 15-17, 1962), ed. by G. L. Fischer, Jr., D. K. Pollock and others. Washington, McGregor and Werner, 1962, p. 209-212.

Progress has been made in characterizing handwritten strokes and applying this to the handwriting recognition problem. It has been found that only 18 strokes are used to construct all of the English characters. These strokes can be generated and joined together by simple rules in a computer so as to write any word. By finding the ranges of the stroke parameters for an individual,

the computer can forge his handwriting. A set of simple tests has been developed on the strokes in a word which enables a computer to pick likely words from a dictionary. Presently these tests are to count the closed loops, the tails above and below the small letters, and the axis crossings at the center of the word. Plans for future work are presented.

1878

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RELAXATION SPECTRA OF SOME NICKEL (II) AND COBALT (II) COMPLEXES, by G. G. Hammes and J. I. Steinfeld. [1962] [5]p. incl. illus. 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 National Institutes of Health)
Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 4639-4643, Dec. 20, 1962.

The rate constants for the formation and dissociation of Ni(II) and Co(II) complexes with 1, 2, and 3 glycine, diglycine, or imidazole molecules have been determined by the temperature-jump technique. The approximate time scale of the reactions studied ranged from 0.1 to 500 msec. The rate constant of dissociation obtained by normalizing with respect to electrostatic and steric factors is characteristic of a given metal ion, and was generally 20 to 25 times greater for Co(II) than for Ni(II). The difference in the corresponding activation energies is predictable on the basis of crystal-field theories. Gylcine is bound to the metal via the negatively charged carboxyl group, hence the normalized rate constants increase in reactions involving the higher complexes, independently of the number of ligands bound if the bonding takes place via unchanged groups.

1879

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SELF-DIFFUSION AND IMPURITY-CONTROLLED PROTON RELAXATION IN LIQUID METHANE, by J. V. Gaven, Jr., J. S. Waugh, and W. H. Stockmayer. [1962] [4]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 National Institutes of Health)
Unclassified

Published in Jour. Chem. Phys., v. 38: 287-290, Jan. 15, 1963.

Self-diffusion in liquid methane, under its own vapor pressure, has been studied between the triple point and the normal boiling point by means of the spin-echo technique. The activation energy for self-diffusion is approximately 0.67 kcal/mol. These results are compared with the constant-pressure tracer results of Naghizadeh and Rice (item no. 505, Vol. V), which show somewhat higher (~ 15%) self-diffusion coefficients and an activation energy of approximately 0.83 kcal/mol. The temperature dependence of self-diffusion in liquid methane appears to be comparable on the basis of a classical reduction to corresponding states, by means of critical constants, to that in liquid Ar, Kr, and Xe. Measurements of the proton spin-lattice relaxation time in our sample indicate that the relaxation is predominantly contr ed by the mutual diffusion of the hydrocarbon and t l amounts of dissolved oxygen. (Contractor's abstr

1880

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOME PROBLEMS IN NONLINEAR THEORY, by M. Schetzen. July 6, 1962, 53p. incl. diagrs. refs. (Technical rept. no. 390) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108)
AD 278691 Unclassified

The first problem considered is the extension of the Wiener theory of nonlinear systems to include non-Gaussian inputs and error criteria other than the mean-square-error criterion. The second problem is the development of a procedure for the experimental determination of higher-order correlation functions without the use of delay lines. An application of this procedure is made to the synthesis N'th-order Gaussian processes. These processes have the property that their first N joint moments are those of a Gaussian process. The third problem is that of nonlinearly coupled oscillators. For this problem, a statistical model is proposed for a class of oscillators that are not phase-locked. Calculations based on this model demonstrate the effect of second-order nonlinearities upon the spectrum of the coupled oscillators. The fourth problem is that of locating noise sources in space by crosscorrelation techniques. For this problem, expressions are derived for the ambiguity in locating a target as a function of the time of observation when using this crosscorrelation technique with a given configuration of N antennas. (Contractor's abstract)

1881

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOME QUANTITATIVE METHODS FOR THE STUDY OF SPONTANEOUS ACTIVITY OF SINGLE NEURONS, by R. W. Rodieck, N. Y.-S. Kiang, and G. L. Gerstein. [1962] [18]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], National Institute of Neurological Diseases and Blindness, and National Science Foundation)
Unclassified

Published in Biophys. Jour., v. 2: 351-368, July 1962.

Four different illustrative examples of single unit data from the cochlear nucleus of anesthetized cats are presented. The spontaneous activity of each of these 4

units can be quantitatively described by the histogram of interspike intervals and by other related measurements. Several descriptive models are suggested by these measurements. (Contractor's abstract)

1882

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

STABILITY AND RESETTABILITY OF He-Ne MASERS (Abstract), by T. S. Jaseja, A. Javan and others. [1962] [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., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 553, Nov. 23, 1962.

The frequency stability of 2 He-Ne masers under quiet acoustical and thermal conditions has been examined. A beat frequency was obtained between the 2 masers with short-term frequency width less than 100 cps corresponding to a frequency fluctuation smaller than 3×10^{-13} over a period of about 4 sec. This represents 2×10^{-11} cm change of length of our 60-cm masers. Under good conditions, the average frequency drift due to thermal fluctuations varied less than 50 cps during 1 sec. Similarly, the average frequency drift over periods as long as a few minutes was also small. This is considerably better than that reported previously, but greater than fundamental thermal fluctuations by about one order of magnitude; hence, further refinement can be expected. The frequency resettability was obtained repeatedly better than 1×10^{-9}. These results demonstrate the applicability of optical masers to detecting very small changes in length or position or to standards of length. These activities were carried out in an acoustically isolated vault at MIT Round Hill with particular geological location leading to a high degree of isolation from man-made microphonic disturbances.

1883

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STUDY OF CONTROL OF EYE MOVEMENTS IN MAN BY MEANS OF AUTOCORRELATION AND CROSS-CORRELATION (Abstract), by J. S. Barlow. [1962] [1]p. (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)
Unclassified

Presented at Spring meeting of the Biometric Soc., Chapel Hill, N. C., Apr. 12-14, 1962.

Published in Biometrics, v. 18: 421, Sept. 1962.

In recent years, the application to biological problems of mathematical techniques of analysis has had a very rapid growth that has been greatly facilitated by the availability of automatic computers. An example is the use of autocorrelation and crosscorrelation analysis in the study of electroencephalograms. In the present report, another example is given; some results from a quantitative study of the nature of the control of eye movements in man. Simultaneous recordings onto magnetic tape were made of: (1) position of the eyes with respect to the head; (2) orientation of the head in space; and (3) position of an object for visual tracking. Analyses of the recordings were made by means of a special-purpose analog computer designed for correlation analysis. Comparison of the results for a normal subject with those for a patient who had a nonfunctioning labyrinth or vestibular apparatus indicates that the muscle and joint sense provide a considerable degree of stabilization of the eye movements when the head is moved actively or passively with respect to the neck. It is apparent, accordingly, that the vestibular apparatus does not have an essential part in the stabilization of eye movements when the head is moved with respect to the body, if the latter remains stationary.

1884

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A STUDY OF MAGNETOHYDRODYNAMIC PARAMETRIC GENERATORS, by H. H. Woodson, G. L. Wilson, and A. T. Lewis. [1962] [17]p. incl. diagrs. (Sponsored jointly by Aeronautical Systems Division, and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Published in Engineering Aspects of Magnetohydrodynamics; Proc. of the Third Symposium, Rochester, N. Y. (Mar. 28-29, 1962), New York, Gordon and Breach, 1964, p. 362-379.

The parameters of a simplified equivalent circuit are derived and, in terms of these parameters, the conditions for self-excitation are given. An experiment is described which shows that the circuit parameters may be obtained approximately from measurements in the sinusoidal steady state on a stationary geometry, and that the values obtained allow a fairly accurate prediction of the actual generator behavior. This allows the circuit parameters to be related to the magnetic Reynolds number, R_m, of the gas flow and to the generator geometry, and allows the determination of a minimum R_m for self-excitation and of the efficiency of the generator.

1885

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TABLES AND FORMULAS FOR CALCULATING FOURIER COEFFICIENTS OF POWER-LAW DEVICES, by P. Penfield, Jr. Mar. 20, 1962, 20p. incl. tables.

(Technical rept. no. 385) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 277027 Unclassified

Tables and formulas are given to facilitate the calculation of Fourier coefficients of power-law devices that are driven from a sinusoidal source. (Contractor's abstract)

1886

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TAKE-HOME LABORATORIES, by R. D. Thornton. [1962] [5]p. incl. illus. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and Ford Foundation) Unclassified

Published in Jour. Eng. Education, v. 52: 554-558, May 1962.

A take-home laboratory kit is described and its application to academic teaching and research is discussed. Some experimental work can be done at home with a resulting increase in freedom and effectiveness in the use of in-school laboratory facilities. The project type of experiment can be extended over several weeks without exorbitant expense. Experimental home problems can be assigned in subjects that have no need of a scheduled laboratory. Experimental creativity becomes a possibility at the undergraduate level since students have more chance for original experimental work.

1887

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THERMAL AND MATERIAL PROBLEMS IN A CONTROLLED FUSION BLANKET (Abstract), by W. G. Homeyer, A. J. Impink and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], MIT Computation Center and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 157, Feb. 28, 1963.

Nuclear heating in thermonuclear-blanket structures has been calculated by the neutronics code for the systems described in a previous paper. Relative heat deposition in the standard configuration was 19.8% in the vacuum wall, 22.5% in the wall coolant, 55% in the primary attenuator, 2.7% in the coil shield, and 0.003% in the coils. In vacuum walls of 1- and 3-cm Mo, 12.5% and 26%, respectively, were deposited. Other modifications had little effect. Total heating was 17.9 mev per D-T neutron. Tritium recovery at low concentration appears easy. It is unlikely that less than 110 cm of blanket can adequately shield superconducting coils while breeding tritium. Blanket thicknesses and other considerations dictate a large cylindrical system (2 m vacuum wall diam, 1000 mw thermal or more) with deposited heat flux in the order of 1.5 mw/m^2 on the vacuum wall. Thermal stress and heat transfer would be limiting at a few times this value; hence, an economic pulsed system would be much more difficult.

1888

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TOLERABLE ERRORS OF NEURONS FOR INFALLIBLE NETS, by M. Blum, N. M. Onesto, and L. A. M. Verbeck. [1962] [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 Redundancy Techniques for Computing Systems; Proc. of the Symposium, Washington, D. C. (Feb. 6-7, 1962), ed. by R. H. Wilcox and W. C. Mann, Washington, Spartan Books, 1962, p. 66-69.

It is shown that circuits can be so designed that the input-output function is correct, although the threshold, strength of stimuli and even the connectivity may be in error so much that each individual formal neuron would make mistakes. Only nets designed to have n input lines that feed signals to n input neurons that, in turn, feed signal to a single output neuron are considered. The function computed by the net is represented by an input-output table. The fractional error, E, is defined as the ratio of dashes to the total number of places in an output column. If all inputs to a neuron are equally frequent, E is the fraction of times that a neuron might be in error, E_1 is the fractional error of the input neuron with the least number of dashes, and E_2 is the fractional error of the output neuron with the least number of dashes. The maximum values of E_1 and E_2 are computed for a net with error-free output. It is shown that $E_1 \approx 1 - \frac{1}{\sqrt{n}}$ and $E_2 \approx 1 - 2\sqrt{n}\,2^{-\sqrt{n}}$ where n is the number of neurons in rank 1.

1889

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

TRITIUM REGENERATION IN A CONTROLLED FUSION BLANKET (Abstract), by A. J. Impink, W. G. Homeyer and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], MIT Computation Center, and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 157, Feb. 28, 1963.

Calculations were made for the neutron-absorbing and

tritium-regenerating blanket for a steady-state D-T reactor. A 50-energy-group 5-spatial-region code was developed to treat neutron reactions in the entire range from 14 mev downward; integral transport S_n and diffusion-theory methods were used to approximate neutron transport in slab and cylindrical configurations. The blanket regions are, in order from the plasma: (1) vacuum wall (1, 2, or 3 cm Mo, or 1 cm Ni); (2) wall coolant (6.25 cm fused salt-Li_2BeF_4 of natural 20% or 50% Li^6; or $LiNO_2$); (3) primary attenuator (56 cm, 25% C, 75% fused salt as above, with or without added Be or BeO); (4) coil shield (30 cm Pb plus borated H_2O, 20 cm LiH, and 6 cm Pb); (5) superconducting coils (10 cm Mo nuclear equivalent). 2 cm Mo, natural Li_2BeF_4, no added Be, was standard; tritium production was 1.16/D–T neutron. Individual variations gave: 1.20 and 1.24 with 20% and 50% enriched Li^6; 1.35 with 5 cm Be; 1.20 with 9 cm BeO; 1.03 with Ni; 0.82 with $LiNO_2$. Tritium production of about 1.15 per D–T neutron will probably be necessary to offset losses.

1890

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ULTRASONIC DISPERSION IN LIQUID HELIUM BELOW 1 °K (Abstract), by W. M. Whitney and C. E. Chase. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency and 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., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 621, Dec. 27, 1962.

Precise measurements of the velocity of sound in liquid helium under the saturated vapor pressure, previously reported for 1 mc sec, have been extended to 4 and 12 mc sec. Within experimental error, the measured total change in velocity between 1.2 and 0.15 K, the lowest temperature reached, is the same at all 3 frequencies, but there is dispersion at intermediate temperatures. At each frequency, the velocity rises from its value at $T = 0$ very nearly as T^3, goes through a maximum, and then decreases rapidly at higher temperatures. At temperatures below that of the maximum, the results at a given frequenc can be quite well represented by the empirical equation $u = u_0 + (13.5 + 1.5f)T^3$ cm sec, where u_0 - 23827 cm sec and f is the frequency in mc sec. For f = 1.00, 3.91, and 11.90 mc sec, the maximum value of $(u - u_0)$ is 5, 7, and 11 cm sec and occurs at the temperature 0.67, 0.71, and 0.72 °K.

1891

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE UTILITY OF ANASTOMOTIC NETS, by W. S. McCulloch. [1962] [5]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, Bell Telephone Labs., National Institutes of Health, and Teagle Foundation, Inc.) Unclassified

Published in Redundancy Techniques for Computing Systems; Proc. of the Symposium, Washington, D. C. (Feb. 6-7, 1962), ed. by R. H. Wilcox and W. C. Mann. Washington, Spartan Books, 1962, p. 62-65.

A net of 3 neurons with 2 inputs each with thresholds modulated by input from the net can be made to compute 15 of the 16 possible logical functions of 2 arguments and 4 neurons with 3 inputs each, 253 logical functions of 3 arguments. The number increases rapidly with the number of inputs per neuron.

1892

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

VALIDITY OF THE GINZBURG-LANDAU THEORY OF SUPERCONDUCTIVITY AT LOW TEMPERATURE (Abstract), by D. H. Douglass, Jr. and R. H. Blumberg. [1962] [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., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 4, Jan. 24, 1962.

The original Ginzburg-Landau (GL) theory consists of assumptions concerning the form of the magnetic field and the field-free parts of the free energy. The field-free portion, which is derived by expanding in a power series valid only near T_c, is, nevertheless, well behaved at low temperatures. The GL theory can be generalized to include any field-free function [the Gorter-Casimir (GC) free-energy expression is one] covering all T, whose expansion near T_c is the same as that of the original theory. The critical field of a thin film can be expressed in terms of this generalized function. The differences between various functions can be expressed in terms of a parameter α which can be measured experimentally at the lower temperatures. Theoretical values of α are + 0.25 and -0.75 for the GL and the GC functions, respectively. Experimental measurements on thin films of tin give a value of $\alpha = 0.14 \pm 0.10$, which seems to favor the original GL theory.

1893

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE WAKE OF A CHARGED PARTICLE MOVING THROUGH A PLASMA WITH MAGNETIC FIELD, by S. K. Majumdar. Sept. 14, 1962, 36p. incl. diagrs. refs. (Technical rept. no. 401) (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 Proc. Phys. Soc. (London), v. 82: 669-638, Nov. 1, 1963.

The motion of a charged particle through a low-density electron plasma placed in an external constant magnetic field has been investigated by using transport equations. The motion of the particle in the direction of the applied magnetic field is considered in detail; the particles moving at right angles to the magnetic field are considered briefly. The charge density developed in the medium as a result of interaction of the medium with the moving particle through long-range Coulomb force is evaluated for the wavelength, λ, which is such that $R > \lambda > \lambda_D$, where R is the distance from the moving particle, and λ_D, the Debye wavelength. Three types of charge-density waves are associated with the moving test particle. One is a plasma electron wave that exists only for velocities of the test particle that are greater than the average thermal speed of the plasma electron; this wave also shows a Mach cone distribution. The second is an elliptically shaped extraordinary electromagnetic wave that exists for all velocities of the test particle, and is coupled to the plasma electron wave. The third is an almost spherical weak wave associated with the ordinary electromagnetic wave. This third wave is not coupled to the other 2 waves within the range of approximation considered here, and it goes over to an exponentially decreasing charge distribution in the limit of very small magnetic field. (Contractor's abstract)

1894

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PHENOMENOLOGICAL THEORY OF SUPERIMPOSED FILMS OF NORMAL AND SUPERCONDUCTING METALS, by D. H. Douglass, Jr. [1962] [5]p. incl. diagrs. refs. (AFOSR-J980) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-87376) Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 155-159, Aug. 15, 1962.

By introducing the concept of the superconducting state of a normal metal, a theory has been derived to explain the observed superconducting behavior of superimposed films.

1895

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR MOMENTS IN FLUCTUATING FIELDS. IV. APPLICATION TO KINETIC PROCESSES, by J. S. Waugh. [1962] [5]p. incl. refs. (AFOSR-J1382) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and [Signal Corps] under DA 36-039-sc-87376, and National Institutes of Health) AD 403623 Unclassified

Also published in Faraday Soc. Discussions, No. 34: 160-164, 1962.

The effects of time-dependent perturbations, particularly chemical reactions, on high resolution nmr spectra are discussed. Some speculations are made about the possibility of observing orthopara conversion in molecules larger than H_2 and about the implications of this process for the motions of molecules in fluids. (Contractor's abstract)

1896

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR RELAXATION AND INTERMOLECULAR FORCES IN GASES, by J. S. Waugh and C. S. Johnson, Jr. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-J1383) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-87376, and National Institutes of Health) Unclassified

Also published in Faraday Soc. Discussions, No. 34: 191-198, 1962.

The origins of nuclear relaxation in relatively dilute monatomic and polyatomic gases are discussed qualitatively, with particular reference to the connection between relaxation times and anisotropic intermolecular potentials. Experimental results are given for mixtures of hydrogen with other gases, and inelastic cross-sections for orientational relaxation with $\Delta J = 0$ are deduced. In the cases studied, a given m_J state appears to persist at room temperature for 4-100 collisions. The effect of paramagnetic impurities at the higher concentrations and densities is briefly discussed. (Contractor's abstract)

1897

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NEGATIVE L AND C IN SOLID-STATE MASERS, by R. L. Kyhl, R. A. McFarlane, and M. W. P. Strandberg. [1962] [16]p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-87376) Unclassified

Published in Proc. Inst. Radio Engineers, v. 50: 1608-1623, July 1962.

The analysis of solid-state cavity masers is extended to include the reactive component of the paramagnetic resonance. This reactance is inverted (in opposition to Foster's reactance theorem). A 2-cavity network makes use of this negative frequency dependence of reactance to obtain a broad-band flat-topped amplifier response. In verification of this theory a ruby maser has been built which has a 95-mc bandwidth at 14-db gain and operates at 9000 mc and 1.5°K. This performance is comparable to that of published, tapered magnetic field traveling-wave masers. General network limitations on cavity maser amplifiers are derived. Broad-banding techniques that have been published for parametric amplifiers are essentially equivalent. The tuning of the broad-band amplifier is critical. The same performance can be achieved in a unilateral transmission maser by using circularly polarized cavities, but the problem of circuit design and tuning with the increased number of parameters has thus far prevented successful operation. (Contractor's abstract)

1898

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RESEARCH ON PARAMAGNETIC RESONANCES, by R. L. Kyhl and M. W. P. Strandberg. Quarterly progress rept. no. 7, May 15-Aug. 15, 1962, 22p. incl. illus. diagrs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research] and Signal Corps under DA 36-039-sc-87376) AD 291881 Unclassified

Further improvements were made in the microwave phonon generator. Spin-lattice relaxation experiments on ruby have been performed and comparison of the results with solutions of the rate equations has been made. Finally, preliminary results on Fe, Mn, and Co-doped potassium tantalate are reported. (Contractor's abstract)

1899

Massachusetts Mental Health Center, Boston.

SPECIAL MODIFICATIONS OF THE SILVER-SILVER CHLORIDE SPONGE ELECTRODE FOR SKIN RECORDING, by D. N. O'Connell and B. Tursky. [1962] [7]p. incl. diagrs. table. (AFOSR-2116) (AF 49(638)728) Unclassified

Also published in Physchophysiol. Newsletter, v. 8: 31-37, Apr. 1962.

Two modifications of the silver-silver chloride sponge electrode designed for ready attachment in a wide range of placements are described. The first modification is for permanent use in both the experimental and clinical situations; the second is for more specialized situations where reuse is not required. The core of the modified electrode is identical with that of the GSR type, so that they are also suitable for recording potential, resistance, or impedance.

1900

Massachusetts Mental Health Center, Boston.

PHYSIOLOGICAL EFFECTS OF PAINFUL STIMULATION DURING HYPNOTIC ANALGESIA UNDER CONDITIONS DESIGNED TO MINIMIZE ANXIETY, by R. E. Shor. [1962] [20]p. incl. diagrs. tables, refs. (AFOSR-64-0829) (In cooperation with Harvard U. Medical School, Boston, Mass.) (Sponsored jointly by Air Force Office of Scientific Reserrch under AF 49(638)728, Human Ecology Fund, and National Institute of Mental Health) AD 438646 Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 10: 183-202, July 1962.

A statistically powerful experimental test of the physiological effects of painful stimulation during hypnotic analgesia was conducted under conditions designed to minimize anxiety. From the findings of no significant differences between the experimental conditions, the plausible interpretation was advanced that, inasmuch as the subjective experience of pain is eliminated during hypnotic analgesia, those physiological reactions do not occur which would otherwise ordinarily result from the stressful or threatening qualities of the painful stimulation tion. It was further advanced, however, that anything else which minimizes the incidental anxiety component of the total pain experience—such as ego-protective procedures in the waking state—can have an effect on physiological responses to painful stimulation similar to that of hypnotic analgesia. (Contractor's abstract)

1901

Massachusetts Mental Health Center, Boston.

BIOELECTRIC CORRELATES OF HYPNOSIS: AN EXPERIMENTAL REEVALUATION, by D. N. O'Connell and M. T. Orne. [1962] [13]p. incl. diagrs. tables, refs. (AFOSR-64-0830) (In cooperation with Harvard U. Medical School, Boston, Mass.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)728, Human Ecology Fund, National Institute of Mental Health) AD 438387 Unclassified

Also published in Jour. Psychiatric Research, v. 1: 201-213, Dec. 1962.

The purpose of this investigation was (1) to determine the magnitude and reliability of changes in potential during hypnosis and (2) if reliable changes were found, to determine whether they originate from the head, from the palms, or from both locations. It was found that previously reported bioelectric changes were found to be palmar in origin. No evidence was found to indicate the presence of cortical potential changes during hypnosis. Large and reliable changes in plamar potential level were observed during hypnosis. These changes were (1) an increase in level of palmar potential of the order of magnitude of 10-30 mv, the increase in level

shifting gradually and returning (usually) dramatically to previous levels at the termination of hypnosis, and (2) a marked smoothing of ongoing activity. These changes are most striking when only general suggestions of deepening hypnotic trance are made, specific suggestions tending to decrease the level of potential. These findings are tentatively interpreted as indicating that the hypnotic state is a state of increased central activation and focused attention. The level of arousal is not that found in sleep but rather that found during highly alert wakefulness.

1902

Massachusetts Mental Health Center, Boston.

AN ANALYSIS OF THE EFFECTS OF MOTION UPON AUDITORY FUNCTION DURING PROLONGED ATYPICAL STIMULATION, by S. J. Freedman and S. K. Secunda Apr. 1962 [54]p. incl. diagrs. tables, refs. (AFOSR-2078) (AF AFOSR-62-11) AD 436180 Unclassified

Presented at Eastern Psychological Assoc. meeting, Atlantic City, N. J., Apr. 1962.

The present experiment attempts to ascertain which components of gross bodily movement are responsible for the increased variability in dichotic time difference discrimination. Four 1-hr exposure conditions were employed during which the subjects heard continuous white noise loud enough to mask background sounds. The conditions were: (1) ambulatory, (2) recombent, (3) active head rotation, and (4) active whole body rotation. After exposure in the ambulatory condition, subjects showed significantly increased variability in the criterion task. Performance also deteriorated significantly with active head rotation and active whole body rotation. When bodily movements were restricted, however, there was essentially no increased variability. Thus, self-produced rotation while listening to dichotic noise is sufficient to disrupt a fundamental cue for auditory localization.

1903

Massachusetts Mental Health Center, Boston.

A STUDY OF VISUAL IMAGERY PRODUCED BY RHYTHMIC PHOTIC STIMULATION, by P. A. Marks. Apr. 1962, 5p. (AFOSR-2079) (AF AFOSR-62-11) AD 436181 Unclassified

Presented at Eastern Psychological Assoc. meeting, Atlantic City, N. J., Apr. 1962.

Photic stimulation provides a way of dependably producing imagery in a laboratory setting. This imagery resembles that which occurs in other situations. Both qualitatively and quantitatively, photic stimulation imagery varies greatly from subject to subject, and these individual variations seem related to definable personality and experiential factors. Such relationships provide leads for studying the factors at work in other types of imagery experience.

1904

[Massachusetts Mental Health Center, Boston.]

ADAPTATION AND TRAINING EFFECTS IN ERG: I. LONG-TERM ADAPTATION, by S. J. Freedman and L. Ronchi. [1962] [6]p. incl. diagrs. (AFOSR-3938) (In cooperation with Istituto Nazionale di Ottica, Florence (Italy)) [AF AFOSR-62-11] AD 449993 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 17: 381-386, July-Aug. 1962.

An experiment is described in which ERG responses of 3 well-trained subjects were measured for 10 consecutive days. Plotting mean scotopic b-wave amplitudes from day to day demonstrated a systematic decline in response level for the early days of the experiments. Previous data from the same subjects lends support to these findings. It is suggested that such long-term adaptation may be typical of perceptual performance in general. (Contractor's abstract)

1905

Massachusetts U. Dept. of Chemistry, Amherst.

A THEORY OF LINEAR DYNAMIC BIREFRINGENCE, by R. S. Stein and S. Onogi. [1961] [21]p. incl. diagrs. refs. (AFOSR-1061) (AF AFOSR-61-28) Unclassified

The birefringence response of a Maxwell element to a sinusoidal strain is calculated assuming different strain-optical coefficients for the spring and dashpot elements. The composite response resulting from a distribution of such elements is calculated. This involves 2 distribution functions for the strain-optical coefficients of the 2 types of elements. Means for experimentally determining the spectra of these functions are discussed.

1906

Massachusetts U. Dept. of Chemistry, Amherst.

THE DYNAMIC BIREFRINGENCE OF HIGH POLYMERS, by R. S. Stein, S. Onogi, and D. A. Keedy. [1962] [21]p. incl. diagrs. refs. (AFOSR-2890) (AF AFOSR-61-28) AD 612354 Unclassified

Presented at Internat'l. Symposium on Macromolecular Chemistry, Montreal (Canada), July 27-Aug. 1, 1961.

Also published in Jour. Polymer Sci., v. 57: 801-821, Mar. 1962.

The simultaneous measurement of the birefringence and strain of a sample subjected to sinusoidal strain is proposed as a means for elucidating the molecular mechanism of the response of high polymers to mechanical deformation. A linear phenomenological theory is proposed in which strain-optical coefficient distribution functions are assigned to the elastic and viscous members of a distribution of Maxwell elements. An apparatus has been constructed to determine the dynamic

strain-optical coefficient at frequencies between 0 and 600 cps by means of mechanical excitation of vibration at low frequencies and electromagnetic at high frequencies. The dynamic birefringences of polyethylene was studied at room temperature over this frequency range.

1907

Massachusetts U. Dept. of Chemistry, Amherst.

DYNAMIC BIREFRINGENCE OF HIGH POLYMERS II, by R. S. Stein, S. Onogi and others. Apr. 30, 1962 [12]p. incl. diagrs. refs. (AFOSR-2925) (Sponsored jointly by Air Force Office of Scientific Research as progress rept. no. 4 under AF AFOSR-61-28, Office of Naval Research as technical rept. no. 44, and Petroleum Research Fund) AD 277402 Unclassified

Also published in Jour. Appl. Phys., v. 34: 80-89, Jan. 1963.

The time-dependence of birefringence was investigated in experiments involving relaxation at constant strain, extension at constant rate of strain, and periodically varying strain. The results of constant strain relaxation are calculated from the other 2 types of experiments using the linear phenomenological theory of birefringence relaxation. Strain-optical coefficient spectra are calculated for a number of low- and high-density polyethylenes and characteristics of the spectra are correlated with sample density. A simple molecular theory is presented. The time-dependence of birefringence is believed to principally arise from the finite relaxation time for crystal orientation. (Contractor's abstract)

1908

Massachusetts U. [Dept. of Psychology] Amherst.

PROBABILITY OF DETECTION AND SPEED OF RESPONSE IN SIMPLE MONITORING, by W. H. Teichner. [1962] [6]p. incl. diagrs. (AFOSR-2362) (AF AFOSR-62-202) Unclassified

Also published in Human Factors, v. 4: 181-186, Aug. 1962.

Two simple monitoring experiments were performed to study the dependence of probability of detection and of speed of response to detected signals on the initial probability of detection of the signal established psycho-physically and on duration of the task. The results indicated that: (1) detection during the task is directly related to the probability of signal detection before the task and inversely related to length of watch, and (2) the speed of response to these signals which are detected is directly dependent on the probability of detection before the watch but independent of factors which operate during the watch.

1909

Matrix Corp., Arlington, Va.

OBTAINING SUBJECTS FOR RESEARCH, by E. E. Smith. [1962] [2]p. (AFOSR-1587) (AF 49(638)1000) AD 436283 Unclassified

Also published in Amer. Psychol., v. 17: 577-578, Aug. 1962.

Five sources are suggested for obtaining subjects for research in social psychology when no captive subjects are available. Their adequacy is discussed. These 5 are: (1) United States Employment Service, (2) Military Reserve Units, (3) Operational Military Units, (4) Prisons and (5) Fire Departments.

1910

Matrix Corp., Los Angeles, Calif.

SOME PERSONALITY AND BEHAVIORAL FACTORS RELATED TO BIRTH ORDER, by E. E. Smith and J. D. Goodchilds. [1962] 12p. incl. tables. (AFOSR-2984) (AF 49(638)1000) AD 445113 Unclassified

Also published in Jour. Appl. Psychol., v. 47: 300-303, 1963.

A study was conducted using 165 firemen in large and small firehouses to test the hypothesis that first borns learn to interact more successfully because of their stronger dependency and affiliation needs. It was also predicted that this greater interactional skill would become more apparent the more complex the social situation. As predicted, first borns had less self-confidence. They also conformed more, were more efficient problem solvers in a group situation, and were more often the official leader of their work group, suggesting that study of the psychology of the early-born may lead to a fresh attack on the leadership problem. However, these group behaviors were only related to birth order in the larger and more complex groups.

1911

Maudsley Hospital, London (Gt. Brit.).

MEMBRANE POTENTIALS IN GUINEA-PIG CEREBRAL CORTEX SLICES IN VITRO. THEIR DEPENDENCE ON SUBSTRATE AND OXYGEN. THE EFFECT OF CLUPEIN AND OF GANGLIO-SIDE PREPARATIONS, by H. H. Hillman. [1961] [5]p. incl. diagr. tables, refs. (AFOSR-2394) (AF 61(052)404) Unclassified

Also published in Jour. Neurochem., v. 8: 257-261, Dec. 1961.

Resting membrane potentials in guinea-pig cerebral cortex slices in vitro in Krebs-Ringer bicarbonate solution with 10 mM-pyruvate, lactate or oxaloacetate as sole substrate are at the same level as with glucose as substrate. They are lower in the absence of substrate, with 10 mM-L-glutamate as sole substrate, or during hypoxia. The membranes are depolarized by hypoxia in

the absence of substrate. The lowering of the resting potential induced by addition of 0.3 mg clupein/ml medium is counteracted by addition of 0.3 mg ganglioside preparation/ml medium.

1912

Maudsley Hospital, London (Gt. Brit.).

ACTIVATION AND INHIBITION OF ADENOSINE TRIPHOSPHATASES OF SUBCELLULAR PARTICLES FROM THE BRAIN, by D. H. Deul and H. McIlwain. [1961] [11]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)404] and Netherlands Organization for the Advancement of Pure Research) Unclassified

Published in Jour. Neurochem., v. 8: 246-256, Dec. 1961.

Guinea pig cerebral cortex disintegrated in sucrose solutions was differentially centrifuged to yield 5 fractions. The activities of the fractions in catalyzing liberation of inorganic phosphate from adenosine triphosphate was measured in the presence of a number of added substances. With Mg, K, and Na ions, the unfractionated suspension liberated phosphate at about 2000 µmol/g cortex/hr; a nuclear fraction at 290, a mitochondrial fraction at 350, a mitochondrial plus microsomal fraction at 490, a microsomal fraction at 590, and a supernatant at 150 umol/hr with material derived from a gram of cortex. Liberation by the mitochondrial fraction was maximal at pH 9 and by the microsomal at 7.5. In media containing Mg and K ions, Na^+ accelerated the activity of the microsomal fraction to a much greater extent than it did that of the mitochondrial fraction. Depending on K^+ concentration and other factors, activation of the mitochondrial fraction was increased by 0-30% and the microsomal fraction by 30-170%. The adenosine triphosphatases were relatively insensitive to simple anions, but were inhibited by preparations of cerebral gangliosides and of the trypanocidal agent suramin.

1913

Maudsley Hospital, London (Gt. Brit.).

GANGLIOSIDES, PHOSPHOLIPIDS, PROTEIN AND RIBONUCLEIC ACID IN SUBFRACTIONS OF CEREBRAL MICROSOMAL MATERIAL, by J. R. Wherrett and H. McIlwain. [1962] [6]p. incl. diagrs. tables, refs. [AF 61(052)404] Unclassified

Published in Biochem. Jour., v. 84: 232-237, Aug. 1962.

In differential centrifuging of cerebral microsomal fractions, gangliosides required lesser centrifugal forces for depositing a given proportion of material than did ribonucleic acid; protein and phospholipids were intermediate in their properties. On density-gradient centrifuging, ribonucleic acid was associated with denser material than the greater part of the gangliosides and phospholipids. On density-gradient electrophoresis, a zone of particles enriched in gangliosides moved more rapidly towards the anode than a zone enriched in ribonucleic acid; phospholipid and protein were associated equally with the 2 zones. Sodium deoxycholate and Lubrol caused greatest solubilization of gangliosides from microsomal material; sodium hydrogen carbonate solubilized most ribonucleic acid. These and other properties of the fractions suggest that gangliosides may be a characteristic component of the membrane structures observed by Hanzon and Toschi in cerebral microsomal fractions; these are likely to contain also proteins and phospholipids.

1914

Maudsley Hospital, London (Gt. Brit.).

THE SODIUM AND OTHER IONS OF MAMMALIAN CEREBRAL TISSUES, MAINTAINED AND ELECTRICALLY STIMULATED IN VITRO, by H. S. Bachelard, W. J. Campbell, and H. McIlwain. [1962] [8]p. incl. diagrs. tables, refs. [AF 61(052)404] Unclassified

Published in Biochem. Jour., v. 84: 225-232, Aug. 1962.

Cerebral tissues incubated in oxygenated glucose-bicarbonate media rapidly gained sodium. Attempts were made to minimize these changes by alterations in the incubating medium. Rapid preparation of tissue by cutting it in situ yielded samples of lower sodium after incubation; during incubation, a net extrusion of sodium was observed in such samples, at rates of 180-240 µequiv/g of tissue/hr. Electrical stimulation increased the sodium content of the incubated tissue; after cessation of stimulation, the additional sodium was in part extruded. Tissue incubated in media low in sodium content was low in postasium content; when stimulated electrically, the respiratory rate of such tissues changed by -50 to +60% rather than by the +100% shown in media of normal sodium content. The intracellular to extracellular ratios of Na^+ and K^+ ions (based on chloride and inulin spaces) have been calculated for incubated tissues prepared by different techniques and compared with the ration (based on chloride space) in unincubated fresh tissue.

1915

Maudsley Hospital, London (Gt. Brit.).

THE SODIUM-STIMULATED ADENOSINE-TRIPHOSPHATASE ACTIVITY AND OTHER PROPERTIES OF CEREBRAL MICROSOMAL FRACTIONS AND SUBFRACTIONS, by A. Schwartz, H. S. Bachelard, and H. McIlwain. [1962] [12]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)404] and National Heart Institute) Unclassified

Published in Biochem. Jour., v. 84: 626-637, Sept. 1962.

By differential centrifuging of sucrose dispersions of guinea-pig cerebral crotex, 75% of their sodium-stimulated adenosine-triphosphatase activity was obtained in a microsomal fraction; the tissue activity was computed as 1100-1500 umol of phosphate formed/g of fresh tissue hr. Assay conditions for the enzyme, and changes in its activity on keeping, are described. Differential

and density-gradient centrifuging indicated the enzyme system to be associated with the membrane structures rather than the ribonucleic acid granules of the microsomal fraction. Fractions richest in the adenosine triphosphatase possessed negligible succinic dehydrogenase but were enriched in acetylcholinesterase and in cholesterol. A portion of the adenosine-triphosphatase activity was no longer deposited at 6.2×10^6 g/min after treatment of microsomal fractions with deoxycholate, Lubrol W or digitonin; with digitonin, stimulation by sodium was retained to an appreciable degree by the enzyme of the supernatant. The adenosine-triphosphatase activity of untreated microsomal fractions was inhibited by 2,4, 6-trinitrobenzenesulphonate and suramin, in reaction mixtures with magnesium and potassium, or with magnesium, potassium, and sodium salts. Ouabain at 10^{-7} to 10^{-4} mol inhibited with magnesium, potassium, and sodium but not without sodium. Competition was noted between protamine, magnesium, and alkali metals for salt formation with adenosine triphosphate. The data are discussed in relation to the likely functioning of the enzyme system in active sodium and potassium transport.

1916

Maudsley Hospital, London (Gt. Brit.).

SEXUAL DIFFERENTIATION OF THE BRAIN AND ITS EXPERIMENTAL CONTROL, by G. W. Harris and S. Levine. [1962] [2]p. (AFOSR-4201) (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(052)454 and Foundations' Fund for Research in Psychiatry) Unclassified

Also published in Jour. Physiol. (London), v. 163: 42-43, 1962.

The pattern of gonadotrophic release of adult rats injected at 5 days of age with testosterone (females) and oestrogen (males) has been studied. The sexual behavior patterns have also been studied. Administration of testosterone to the new-born female results in a male pattern of gonadotrophic release, absence of female behavior patterns, and enhancement of male behavior. Administration of oestrogen to the new-born male results in a female pattern of gonadotrophic release and, often, loss of all sexual behavior.

1917

Maudsley Hospital, London (Gt. Brit.).

MEMBRANE POTENTIALS IN ISOLATED AND ELECTRICALLY STIMULATED MAMMALIAN CEREBRAL CORTEX. EFFECTS OF CHLORPROMAZINE, COCAINE, PHENOBARBITONE AND PROTAMINE ON THE TISSUE'S ELECTRICAL AND CHEMICAL RESPONSES TO STIMULATION, by H. K. Hillman, W. J. Campbell, and H. McIlwain. [1962] [16]p. incl. diagrs. tables, refs. (AFOSR-J833) (AF EOAR-62-4) AD 416521 Unclassified

Also published in Jour. Neurochem., v. 10: 325-339, May 1963.

Resting membrane potentials measured by micropipette electrodes in guinea pig cerebral cortex in vitro, were of a mean value between -36 and -40 mv. Application of electrical pulses for 1 min diminished the potentials observed 1 min after stimulation ceased. The time-course of recovery of potential was measured after 10 min stimulation: the potentials reached nearly zero and recovered at about -12.5 mv/min. The potentials before application of pulses were increased by 50 μM chlorpromazine and diminished by 0.3 mg/ml clupeine (protamine). Their change with pulses was diminished, or recovery accelerated, by 0.3 mM-phenobarbitone, by 50 μM-chlorpromazine, and by 20 μM-cocaine. These agents did not significantly affect the potassium or non-inulin sodium of tissues incubated in vitro. When however pulses were applied to such tissues, chlorpromazine inhibited the change in sodium and potassium; phenobarbitone permitted the changes but afforded more complete recovery of non-inulin sodium. Spike discharges were observed on 25 occasions on penetrating the isolated tissue with micro-electrodes. They commenced from potentials of -32 to -55 mv, were of +27 to +70 mv, were associated with positive and negative after-potentials and carried a notch on their rising phase. The nature and incidence of the discharges did not appear to be markedly affected by the substances named above, nor by a number of other experimental changes.

1918

Maudsley Hospital, London (Gt. Brit.).

CHARACTERISTICS REQUIRED IN ELECTRICAL PULSES OF RECTANGULAR TIME-VOLTAGE RELATIONSHIPS FOR METABOLIC CHANGE AND ION MOVEMENTS IN MAMMALIAN CEREBRAL TISSUES, by H. McIlwain and P. Joanny. [1962] [11]p. incl. diagrs. tables, refs. (AFOSR-J834) (AF EOAR-62-4) AD 416522 Unclassified

Also published in Jour. Neurochem., v. 10: 313-323, May 1963.

The pulses caused loss of K, gain in Na and increase in respiration by isolated cerebral cortical tissue. These changes commenced at applied potentials 1-2 v and reached maxima at 7.5 v. Pulses of duration between 0.03 and 0.04 msec gave increasing effects. Response increased with increase in frequency between 2 and 30/sec but little greater effect usually ensued with higher frequencies. With submaximal pulses of 5 or 7.5 v, 0.4 msec and relatively low frequencies the initial changes in Na and K per pulse were approximately equivalent and between 5 and 6 mumol/g tissue/pulse. Similar pulses caused a sustained increase in respiration of 1.56 u mol O_2/g tissue/pulse. The increase in respiration was susceptible to inhibition by relatively low concentrations of chlorpromazine, and by phenobarbitone and 1,2,3,4-tetrahydro-5-aminoacridine. Response to sparse pulses was increased by protoveratrine A but response to pulse-types tested was unaffected by 4 other substances including trimethadione.

1919

Max-Planck Inst. für Aeronomie, Lindau (Germany).

TIME PATTERN OF IONIZING RADIATION IN BALLOON ALTITUDES IN HIGH LATITUDES. PART A. TEXT, by G. Pfotzer, A. Ehmert, and E. Keppler. Final rept. Aug. 1, 1962 [55]p. incl. tables, refs. (AFOSR-3440, pt. 1) (AF 61(052)372) AD 284488
Unclassified

During the period from June 12-Aug. 2, 1961, a series of 23 successful unmanned balloon flights were carried out to measure cosmic radiation, solar protons, and x-rays at high altitudes in the auroral zone (Kiruna/Sweden). The equipment and the special viewpoints of the measurements are described in detail. In addition to x-ray events, which occur relatively frequently in the auroral zone, 4 cases of solar proton injection occurring on July 12th, 18th, 20th, and 27th were recorded during the passage of 2 very active plage regions across the solar disk. The various events are briefly discussed. The measurements are counterparts of similar ones carried out simultaneously by American groups.

1920

Max-Planck Inst. für Aeronomie, Lindau (Germany).

TIME PATTERN OF IONIZING RADIATION IN BALLOON ALTITUDES IN HIGH LATITUDES. PART B. FIGURES AND DIAGRAMS, by G. Pfotzer, A. Ehmert, and E. Keppler. Final rept. Aug. 1, 1962 [62]p. incl. illus. diagrs. (AFOSR-3440, pt. 2) (AF 61(052)372)
AD 284490 Unclassified

The results of 23 unmanned balloon flights carried out from June 12-Aug. 2, 1961 are compiled in 45 diagrams (see item no. 1919, Vol. VI).

1921

Max-Planck Inst. für Aeronomie, Lindau (Germany).

SUDDEN INCREASE OF RADIATION INTENSITY COINCIDING WITH A GEOMAGNETIC STORM SUDDEN COMMENCEMENT, by E. Keppler, A. Ehmert and others. [1962] [4]p. incl. diagrs. tables. (AFOSR-J319) (AF EOAR-62-98) AD 408024 Unclassified

Also published in Jour. Geophys. Research, v. 67: 5343-5346, Dec. 1962.

A Geiger-Muller counter carried to 10 mb pressure by a balloon launched from Kiruna, Sweden, recorded a sudden intensity increase coincident with a magnetic sudden commencement on July 31, 1961. The 1 min burst was attributed to x-rays. Similar fluxes were obtained simultaneously by experimenters at Fort Churchill, Canada. Riometer records show increased absorption. It is suggested that this measurement and 2 by other workers at earlier dates indicate a world-wide SC x-ray burst restricted to the auroral zone. The x-rays may arise from electron bombardment of the upper atmosphere.

1922

Max-Planck Inst. für Strömungsforschung, Göttingen (Germany).

[EXPERIMENTAL INVESTIGATION OF THE SCATTERING OF SOUND IN TURBULENT FLOW] Experimentelle Untersuchungen über die Streuung von Schall in turbulenter Strömung, by D. [W.] Schmidt. 1962 [69]p. incl. illus. diagrs. tables, refs. (Rept. no. 28) (AFOSR-3779) (AF EOAR-61-5) AD 293165
Unclassified

Measurements made in a wind tunnel confirm theoretical predictions. A formula which predicts turbulent damping of directional sound is presented.

1923

Max-Planck Inst. für Strömungsforschung, Göttingen (Germany).

DESCRIPTION OF THE METHOD FOR MEASURING THE INFLUENCE OF TURBULENT SCATTERING ON THE PHASE OF SOUND WAVES, by D. W. Schmidt. Final rept. Apr. 1, 1961-Mar. 31, 1962 [14]p. incl. illus. diagrs. (AFOSR-4687) (AF EOAR-61-5)
AD 407887 Unclassified

Experimental investigations of the scattering of sound by turbulence were successfully continued by developing and checking suitable methods for the measurement and registration of phase fluctuations. The main object of the phase measurements was to obtain frequency distributions of the phase fluctuations. This was made possible by the use of a phase-measuring circuit. In order to get a first survey of the behavior of the phase angle of sound scattered by turbulence, approximately 300 dual-beam oscillograms of received sound pulses were taken showing the phase variations on the upper trace and the amplitude variations on the lower trace simultaneously. In the case of laminar flow between sound transmitter and receiver, no measurable fluctuations was present in the phase or amplitude of the received sound.

1924

Max-Planck Inst. für Zellchemie, Munich (Germany).

THE ENZYMATIC DEGRADATION OF TERPENES, by W. Seubert, U. Remberger and others. Final technical rept. Dec. 14, 1962, 53p. incl. diagrs. tables, refs. (AFOSR-4905) (AF 61(052)251) AD 415464
Unclassified

The bacterial degradation of terpenes like citronellol and farnesol is initiated by the oxidation of the primary alcohol group to the carboxyl group. Subsequent degradation of the acid formed occurs at the level of CoA-activated intermediates. After fixation of CO_2 at the branched methylgroup the latter is eliminated as free acetic acid. The straight carbon chain formed is further degraded according to the principles of ß-oxidation to acetyl CoA. Pyruvate carboxylase employed in these studies has been purified 550 times from crude extracts

of Ps. citronellolis. The enzyme catalyzes the ATP and Mg^{++}-dependant carboxylation of pyruvate to oxalacetate. Biotin acts as the prosthetic group of the enzyme. By exchange studies with radioactive compounds, a CO_2-biotin-enzyme has been shown to participate in the carboxylation of pyruvate. In contrast to the mammalian pyruvate carboxylase, the enzyme isolated from bacteria catalyzes the above reaction in the absence of acetyl CoA. The implication of this observation regarding possible different carboxylation mechanisms in bacterial and mammalian systems is discussed.

1925

Méditerranéen de Recherches Thermodynamiques, Nice (France).

EXPERIMENTAL STUDY OF THE STAGNATION TEMPERATURE IN A FREE MOLECULAR FLOW, by F. M. Devienne. [1956] [5]p. incl. diagrs. tables. (AFOSR-3512) (AF 61(052)124) Unclassified

Also published in Jour. Aeronaut. Sci., v. 24: 403-406, 412, June 1957.

The purpose of the experimental work described in this paper was the measurement of the temperature of a small thermally insulated flat plate in motion at high speed in a free molecular flow. The plate was oriented perpendicular to the direction of motion, and was fixed at the extremity of an arm which revolved at high speed in a vacuum chamber. The experimental results indicate that the temperature increase of the plate is a function of the speed of the plate, the pressure in the chamber and the surface condition of the plate. The results were compared with values calculated from the theory for free molecular flow, which gives the temperature increase of the plate as a function of the molecular speed ratio, the total emissivity and the thermal accommodation coefficients of the surface. In general, the experimental values for the temperature increase were less than those predicted by theory, when values for ϵ and α taken from tables of constants were used in the theoretical formulas. The theory, which assumes a Maxwellian distribution of molecular velocities, can be brought into accord with the experimental findings only if it is assumed that the accommodation coefficient is a function of pressure and speed. (Contractor's abstract)

1926

Méditerranéen de Recherches Thermodynamiques, Nice (France).

THE USE OF REVOLVING DISCS IN THE STUDY OF INTERACTION PHENOMENA BETWEEN MOLECULES AND A SURFACE, by F. M. Devienne and G. M. Forestier. Final rept. Sept. 1962 [50]p. incl. illus. diagrs. (AFOSR-3762) (AF 61(052)124) AD 289285 Unclassified

Results show that the dispersion of molecules reflected by a moving surface is very different from the dispersion when the same surface is at rest; the higher the speed the greater the difference. The re-emission distribution curve in a plane normal to the surface is a circle. But, when the surface is moving, the distribution curve has an elliptic form. The modulus of the vector corresponding to the number of molecules re-emitted in a given direction passes through a maximum for an angle to the horizontal which depends on the speed and on the nature of the gas. This dependence can be summed up by the variation versus σ which is the ratio of the speed of motion to the arithmetical mean speed of the molecules of the beam.

1927

Méditerraneen de Recherches Thermodynamiques, Nice (France).

EXPERIMENTAL RESEARCHES ON CHARGE OR MOMENTUM EXCHANGE BETWEEN IONS AND MOLECULES IN ORDER TO OBTAIN HIGH SPEED MOLECULAR BEAM, by F. M. Devienne, B. C. Crave and others. Final rept. Aug. 1962 [46]p. incl. diagrs. (AFOSR-3783) (AF 61(052)561) AD 287761 Unclassified

An analysis is presented on the main methods used to determine physical data which characterize the high speed molecular beam, and in particular, the speed of molecules and the efficiency of the exchange processes.

1928

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

[OBSERVATIONS ON THERMODYNAMICS AND THE THEORY OF FINITE ELASTICITY] Observazioni sulla thermodinamica e sulla theria dell'elasticità finita, by B. D. Coleman. July 1961, 22p. (AFOSR-1324) (AF 49(638)541) Unclassified

A general theory of mechanically admissible stress-strain functions is first considered. Thermodynamical admissibility is defined in terms of an integral inequality for $\hat{S}$ (the stress tenso. S at a material point is given by a function $\hat{S}$ of the deformation gradient at that point). It is shown that a stress-strain function both mechanically and thermodynamically admissible from the present point of view must also be compatible with Green's theory of elasticity. A very simple form for the inequalities of $\hat{S}$ necessary and sufficient for thermodynamical admissibility in a perfect fluid is discussed. The concept of partial thermodynamical admissibility (weaker than thermodynamical admissibility) is also introduced to show that if $\hat{S}$ is partially thermodynamically admissible then $\hat{S}$ can be obtained from an energy function.

1929

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

SUBSTANTIALLY STAGNANT MOTIONS, by B. D. Coleman. [1962] [8]p. (AFOSR-1962) (AF 49(638)541) AD 295972 Unclassified

Also published in Trans. Soc. Rheol., v. 6: 293-300, 1962.

An outline is given of part of the general theory of substantially stagnant motions. These are flows such that, if the present state is taken as a reference, a material point always sees behind itself essentially the same past deformation history. Included in the class of substantially stagnant motions are steady uniform expansion and the viscometric flows such as steady simple shearing flow, steady Poiseuille flow, and steady Couette flow. (Contractor's abstract)

1930

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

STEADY EXTENSION OF INCOMPRESSIBLE SIMPLE FLUIDS. by B. D. Coleman and W. Noll. [1962] [4]p. incl. refs. (AFOSR-2155) (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) AD 295937 Unclassified

Also published in Phys. Fluids, v. 5: 840-843, July 1962.

Steady extension is a flow possible in every incompressible simple fluid (Newtonian, non-Newtonian, or viscoelastic) without neglect of inertia. A special example of this flow is realized by considering a cylindrical fluid mass which is being continually elongated (or shortened) at a rate proportional to its length. The behavior of a general simple fluid in steady extension is determined by material functions other than the viscosity and normal-stress functions which govern viscometric flows. (Contractor's abstract)

1931

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THE ADSORPTION OF FLEXIBLE MACROMOLECULES. PART II THE SHAPE OF THE ADSORBED MOLECULE. THE ADSORPTION ISOTHERM SURFACE TENSION, AND PRESSURE. by A. Silberberg. [1962] [24]p. incl. diagrs. tables. refs. (AFOSR-2347) (AF 49(638)541) AD 295939 Unclassified

Also published in Jour. Phys. Chem., v. 66: 1884-1907, 1962.

The known facts about the adsorption of macromolecules at surfaces are reviewed. A model is introduced in which the adsorbed polymer molecules are attached to the interface by stretches of segments in the surface alternating with loops pending away from it. These loops are considered to set up a thin surface adjoint bulk phase of rather high polymer concentration. The partition function for the entire system is written down, and equations determining the equilibrium values of all variables derived from it. In the process, a method of determining the entropy of mixing of polymer molecules with low molecular weight solvent is introduced and discussed. It is found that adsorption reaches a plateau value which maintains itself over a wide range in concentration. The plateau value is molecular weight dependent, adsorption increasing with increasing molecular weight, but at a decreasing rate, becoming independent of it, when it is very high. The temperature dependence of adsorption is small and segment adsorption energies can be quite low. Despite this the polymer molecules are practically flattened into the surface. Some half of the segments are directly in the surface and the adsorbed layer is very thin. The shape of the adsorbed polymer molecule is largely independent of molecular weight and concentration, but depends strongly on the factors restricting polymer accommodation to the surface. The low rate to equilibrium and the inability to "wash off" adsorbed polymer films is explained. The theoretical isotherm apparently fits a Langmuir plot, but not for the usual reasons. Surface tension decrement and surface pressure are shown to be nearly the same for very dilute polymer solutions. A surface equation of state is derived. Ideal behavior is predicted in the limit of low surface adsorption. (Contractor's abstract)

1932

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THE ADSORPTION OF FLEXIBLE MACROMOLECULES. PART I. THE ISOLATED MACROMOLECULE AT A PLANE INTERFACE, by A. Silberberg. [1962] [12]p. incl. diagrs. refs. (AFOSR-2365) (AF 49(638)541) AD 295938 Unclassified

Also published in Jour. Phys. Chem., v. 66: 1872-1883, 1962.

The adsorption of an isolated, flexible linear polymer molecule of high molecular weight is treated at an infinite plane surface. The question of a possible equilibrium configuration is examined when it is required that some at least of the segments of the polymer molecule are in contact with the surface, and it is assumed that for each segment so placed the internal energy of the system is reduced by an adsorption energy xkT. It is shown that the polymer molecule will split up into sequences of segments; alternate stretches of P_s segments all in the surface and loops of P_B segments all out of the surface, whose size is not a function of molecular weight. The length, P_B, of the loops will decrease and the fraction, p, of segments in the surface will increase as the absorption energy x increases. Several models are considered. For an all adsorbable polymer molecule on an all adsorbing surface, the loops P_B are small and p is large even at small values of x. Such polymer molecules stay close to the surface with practically all their segments, and behave essentially as 2 dimensional structures. In cases where not all surface sites are adsorbing, or not all polymer segments are adsorbable, or both, the size of loop is considerably increased and much higher adsorption energies are required. Restrictions limiting the re-entry of an adsorption loop into the surface, as well as any increase in specificity, have a similar effect. It is shown that structural principles affect polymer adsorption in sensitive fashion. It is one of the consequences of this model that the ends of the polymer molecule are on the surface. A discussion of previous theories, which predicted rather different results, is given.

1933

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

GENERAL THEORY OF STATIONARY RANDOM SEQUENCES WITH APPLICATIONS TO THE TACTICITY OF POLYMERS, by B. D. Coleman and T. G. Fox. [1962] [15]p. (AFOSR-J1198) (AF 49(638)541)
AD 424249 Unclassified

Presented at 142nd meeting of the Amer. Chem. Soc., Atlantic City, N. J., Sept. 9-14, 1962.

Also published in Jour. Polymer Sci., Part A, v. 1: 3183-3197, Oct. 1963.

The assumption of statistical constancy implies that a particular sequence of isotactic (I) and syndiotactic (S) placements will occur independently of the position of the sequence along the chain. Further, one can assume an infinite chain length and neglect end effects. From these assumptions, a general theory covering Bernoullian, Markoffian, and non-Markoffian chain statistics is derived. From this theory, an equation is deduced for the number average length $u(I)$ of closed sequences of isotactic placements $u(I) =$ $[1 - p_1(S)]^{-1}[p_1(S) - p_2(S^2)]$ where $p_1(S)$ is the normal concern of S pairs. Nuclear magnetic resonance spectra may be used to test the validity of the equation even though the statistics may be non-Markoffian.

1934

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

MULTISTATE MECHANISM FOR HOMOGENEOUS IONIC POLYMERIZATION. I. THE DIASTEREOSEQUENCE DISTRIBUTION, by B. D. Coleman and T. G. Fox. [1962] [11]p. incl. refs. (AF 49(638)541)
Unclassified

Presented in part at 142nd National meeting of the Amer. Chem. Soc., Atlantic City, N. J., Sept. 9-14, 1962.

Abstract published in Amer. Chem. Soc. Abstracts of Papers, 1962, p. 14-R. (Title varies)

Published in Jour. Chem. Phys., v. 38: 1065-1075, Mar. 1, 1963.

A mechanism is proposed to explain the "stereoblock" structures which occasionally result from homogeneous anionic polymerizations. The mechanism postualtes that a growing polymer chain has 2 reactive states in dynamic equilibrium, both capable of adding monomer, but each with its own stereospecificity. The resulting diastereosequence distribution is calculated and it turns out to be non-Markoffian. It is shown that the "two-state" polymerization mechanism yields predictions about the dependence of NMR spectra on polymerization conditions, and as such is capable of experimental test. The case of more than 2 states is also discussed.

1935

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

A MULTISTATE MECHANISM FOR HOMOGENEOUS IONIC POLYMERIZATION. II. THE MOLECULAR WEIGHT DISTRIBUTION, by B. D. Coleman and T. G. Fox. [1962] [4]p. incl. refs. (AF 49(638)541)
Unclassified

Published in Jour. Amer. Chem. Soc., v. 85: 1241-1244, May 5, 1963.

To explain the "stereoblock" structures which occasionally result from homogeneous anionic polymerizations, an examination was made of (see item no. 1933, Vol. VI) the diastereosequence distribution resulting from a mechanism in which a reactive polymer chain end has 2 possible states, 1 and 2, in dynamic equilibrium, both capable of adding monomer, but each with its own stereospecificity. The molecular weight distribution resulting from such a mechanism when monofunctional initiators are used is considered. No side reactions are assumed such as irreversible termination or chain transfer; initiation is assumed to be instantaneous. As a result, under certain limiting conditions our molecular weight distribution reduces to the Poisson distribution obtained by Flory for the classical one-species polymerization. In general, however, the present mechanism yields a ratio, r, of the weight to number average degrees of polymerization which is larger than that obtained from the Poisson distribution. Whenever the rate constants for the reactions 1 ⇄ 2 are non-zero, the present distribution shares with the Poisson distribution the property that r approaches unity for long reaction times.

1936

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

ON STRAIN ENERGY FUNCTIONS FOR ISOTROPIC ELASTIC MATERIALS, by L. E. Bragg and B. D. Coleman. [1962] [3]p. (AF 49(638)541)
Unclassified

Published in Jour. Math. Phys., v. 4: 424-426, Mar. 1963.

This article deals with isotropic elastic materials which possess a strain energy function. For such materials the strain energy of a material point is given, of course, by a symmetric function $\bar{\sigma}$ of the principal stretches ν_1, ν_2, ν_3 at tha point. It is known that a necessary condition to have an isotropic material compatible with the axioms for thermostatics proposed by Coleman and Noll is that the function $\bar{\sigma}$ be jointly and strictly convex in its 3 variables ν_1, ν_2, ν_3. It is shown that this condition is not sufficient for compatibility with the thermostatic axioms.

1937

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED STUDY OF THE REACTION OF CH_2 WITH CO_2 IN THE SOLID STATE, by D. E. Milligan and M. E. Jacox. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-2193) (AF 49(638)542) Unclassified

Also published in Jour. Chem. Phys., v. 36: 2911-2917, June 1, 1962.

The photolysis of CH_2N_2 and of CD_2N_2 in CO_2 at temperatures near 50°K has been studied using infrared techniques. Evidence has been obtained for the production of 1 or more intermediates by the reaction of CH_2 with CO_2. These intermediates are precursors of H_2CO + CO. Possible structures for such species are proposed and discussed.

1938

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED SPECTROSCOPIC EVIDENCE FOR THE ROTATION OF THE WATER MOLECULE IN SOLID ARGON, by R. L. Redington and D. E. Milligan. [1962] [5]p. incl. diagrs. tables, refs. (AFOSR-2676) (AF 49-(638)542) Unclassified

Also published in Jour. Chem. Phys., v. 37: 2162-2166, Nov. 15, 1962.

High-resolution spectra of H_2O, HDO, and D_2O suspended in solid Ar have been observed in the range 4°—27°K. Evidence has been obtained for the rotation of these species in Ar matrices. The majority of the observed lines are found to be in very good agreement with low-J transitions of the gas spectra, allowing for a small matrix shift. Transitions arising from both spin modifications of H_2O and D_2O have been observed and the intensities observed suggest that a large degree of spin equilibration has taken place. A small contamination of O_2 may be responsible for this. A perturbation of one of the rotational levels of ν_2- H_2O is discussed. (Contractor's abstract)

1939

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED SPECTROSCOPIC STUDY OF THE PHOTOLYSIS OF HN_3 IN SOLID CO_2, by D. E. Milligan, M. E. Jacox and others. June 1962 [24]p. incl. diagrs. tables, refs. (AFOSR-2847) (In cooperation with California U., Berkeley) (AF 49(638)542 and AF 49(638)-944) Unclassified

Also published in Jour. Chem. Phys., v. 37: 2302-2310, Nov. 15, 1962.

For abstract see item no. 277, Vol. VI.

1940

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

EVALUATION OF LATTICE SUMS IN THE CALCULATION OF CRYSTAL SPECTRA, by R. M. Hexter. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-J1190) (AF 49(638)542) Unclassified

Also published in Jour. Chem. Phys., v. 37: 1347-1356, Sept. 15, 1962.

Transition dipole-transition dipole exciton interaction lattice sums are shown to be amenable to evaluation by the general procedure of Nijboer and de Wette. The practical evaluation of lattice sums in certain cubic and tetragonal crystals is then discussed, with emphasis upon the importance of the manner in which the spectrum of a molecular solid is obtained. The particle size of a polycrystalline sample is shown to strongly affect the value of the lattice sum. For single crystals, the orientation of the crystal and its transition moment directions with respect to the electric vector of the exciting field is of importance. Specific formulas relating crystal field splittings to dipole derivatives (in vibrational spectra) and to oscillator strengths (in electronic spectra) are given and tested with a variety of vibrational transitions of various cubic crystals as well as with the deformation mode of N_3^- in the tetragonal alkali azides. The oscillator strength of the $^1\Pi - {}^1\Sigma^+$ transition of CO is calculated to be 0.148. Splittings in the related transition in solid N_2 are also discussed. Results indicate that several conclusions in earlier calculations based upon dipole coupling models have been in error due to inadequate summation procedures. The results also indicate that exciton packets extend to the boundaries of the crystallites of which a polycrystalline sample is composed. Limitations to the general applicability of the summation procedures presented here are also discussed. (Contractor's abstract)

1941

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED STUDY OF THE REACTIONS OF CH_2 AND NH WITH C_2H_2 IN SOLID ARGON, by M. E. Jacox and D. E. Milligan. [1962] [5]p. incl. diagrs. tables, refs. (AFOSR-1191) (AF 49(638)542) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 278-282, Feb. 5, 1963.

As a part of a systematic study of the reactions of NH and CH_2 with simple unsaturated molecules in an inert matrix, infrared spectral observations have been made on the photolysis products of dilute solid solutions of $C_2H_4 + HN_3$, $C_2H_2 + CH_2N_2$, and $C_2H_2 + HN_3$ in argon at 4°K. The cyclic species ethylenimine is the product of the first reaction. However, radical attack on a triple bond does not appear to lead to a stable cyclic species. Allene is produced by the attack of CH_2 on C_2H_2. Evidence also suggests the production of ketenimine by the analogous reaction of NH with C_2H_2.

Possible mechanisms for these reactions are discussed. These mechanisms suggest that at least part of the CH_2 and NH may undergo matrix deactivation to the ground triplet state before reaction.

1942

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

COMMENT ON "INFRARED ABSORPTION SPECTRA OF LiOH AND LiOD", by R. M. Hexter. [1962] [2]p. incl. refs. (AFOSR-J1192) (AF 49(638)542) Unclassified

Also published in Jour. Chem. Phys., v. 38: 1024-1025, Feb. 15, 1963.

Criticism is made of the suitability of the "factor group" approach to the interpretation of the detailed spectra previously reported by Buchanen et al (Jour. Chem. Phys., v. 36: 2665-2675, May 15, 1962). Certain aspects of the spectra are used to support a model of localized motion of the OH and OD ions (no coupling between the ions) in direct contrast to the correlated motion required by the factor group approach.

1943

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

EXCITATION-MODULATION SPECTROSCOPY: A TECHNIQUE FOR OBTAINING VIBRATIONAL SPECTRA OF EXCITED ELECTRONIC STATES, by R. M. Hexter. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J1194) (AF 49(638)542) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 703-709, June 1963.

A procedure is suggested for direct recording, in the infrared, of the vibrational spectra of excited electronic states of molecules. The procedure resembles the chemical modulation technique of Bair, Lund, and Cross as well as the pressure modulation technique of Gilfert and Williams. Infrared radiation is passed through a sample but is not chopped. Instead, ultraviolet radiation which also impinges upon the sample is chopped at the tuned frequency of the detector-amplifier system. Only those infrared transitions which take place within the vibrational manifold of the state populated due to the ultraviolet light are recorded. Using a simple adaptation of a commercial spectrometer, this makes possible the recording of the infrared spectra of the lowest triplet state of certain molecules. Preliminary results on naphthalene and acetone are reported and necessary improvements in the instrumentation are discussed. The limitations of the entire procedure are analyzed in terms of a simple model in which the excited molecule is supposed to have only one vibrational degree of freedom and the state manifold for that vibration has only 2 levels.

1944

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

SOLID STATE STUDIES OF THE NOBLE (RARE) GASES AND THEIR SOLID SOLUTIONS, by D. R. Sears. Final rept. Mar. 1, 1959-Feb. 28, 1962. Apr. 30, 1962 [60]p. incl. illus. diagrs. tables, refs. (AFOSR-2570) (AF 49(638)575) AD 275596 Unclassified

A spectrogoniometer cryostat has been designed and constructed for studying frozen gases by the x-ray counter diffractometer technique. The instrument is described in detail and its performance is reported. Solid xenon has been studied in the temperature range below 75°K. In particular, lattice parameters and volume expansion coefficients are reported for temperatures below 20°K, hitherto the lower limit of published crystallographic investigations of xenon. A value of 6.1317 ± 0.0005A is obtained for the lattice parameter of xenon extrapolated from 5.5° to 0°K. Incidental observations on krypton, gold, carbon dioxide, and carbon suboxide are reported. (Contractor's abstract)

1945

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

DENSITY AND EXPANSIVITY OF SOLID XENON, by D. R. Sears and H. P. Klug. [1962] [5]p. incl. diagrs. tables. (AFOSR-J161) (AF 49(638)575) AD 400845 Unclassified

Also published in Jour. Chem. Phys., v. 37: 3002-3006, Dec. 15, 1962.

Lattice parameters, densities, and thermal expansion coefficients of polycrystalline xenon are reported for the temperature range from 5.5° to 75°K. A value of 6.1317 ± 0.0005A is obtained for the lattice parameter extrapolated to 0°K. Preferred orientation and annealing effects in frozen gases are discussed briefly with reference to matrix isolation methods. (Contractor's abstract)

1946

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THE PROTON MAGNETIC RESONANCE SPECTRA OF OLEFINS. II. INTERNAL ROTATION IN ALKYLETHYLENES, by A. A. Bothner-By, C. Naar-Colin, and H. Günther. [1962] [4]p. incl. table, refs. (AFOSR-1955) (AF 49(638)980) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 2748-2751, July 20, 1962.

Parameters obtained from the analysis of proton magnetic resonance spectra of several alkylethylenes are reported. From these values and others previously reported, it may be deduced that: (1) The spin-spin coupling constant between protons on adjacent triagonal and tetrahedral carbons depends on the rotational conformation, having a value near 11.5 cps when the protons are trans oriented and near 3.7 cps when they are

gauche oriented; (2) The long-range allylic coupling constants also depend on the rotational conformation, having the smallest absolute value when the allylic proton and the $=CH_2$ group are eclipsed; and (3) In the compounds $RCH_2CH=CH_2$ and $R_2CH-CH=CH_2$, the rotational conformers are about equally populated when $R = CH_3$, but as R is increased in size, the conformation with R and $=CH_2$ eclipsed becomes less favored. (Contractor's abstract)

1947

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

ROTATIONAL ISOMERISM ABOUT SINGLE BONDS IN OLEFINIC COMPOUNDS, by A. A. Bothner-By and H. Günther. [1962] [5]p. incl. diagrs. table, refs. (AFOSR-J656) (AF 49(638)980) AD 414206 Unclassified

Also published in Faraday Soc. Discussions, No. 34: 127-131, 1962.

Analysis of the 60 mc/sec high resolution proton nmr spectra of samples of allyl chloride, allyl bromide, allyl iodide, and allyl benzene in 10% solution in CCl_4 yield sets of coupling constants and chemical shifts from which conclusions may be drawn concerning the relative stabilities of the rotational conformers. In allyl chloride and allyl benzene, that conformer with the substituent gauche to the proton on trigonal carbon is slightly preferred. The preference for this conformer becomes increasingly more pronounced in allyl bromide and allyl iodide. (Contractor's abstract)

1948

Miami U. Dept. of Chemistry, Coral Gables, Fla.

[MIXED REFRACTORY OXIDES], by K. S. Vorres. Final rept. Nov. 1962 [30]p. incl. diagrs. tables, refs. (AFOSR-4071) (AF AFOSR-61-104) AD 290693 Unclassified

The conditions for the appearance of the fluorite-type solid solution with ZrO_2 were investigated experimentally by studying sub-solidus equilibria in the binary systems composed of ZrO_2 and each of CuO, Cu_2O, SnO_2, Ag_2O, Tl_2O, CdO, and Ga_2O_3. No solid-solution formation was observed. The data were correlated with all other data on binary systems with ZrO_2 to determine conditions for the appearance of the fluorite phase. A plot of ionic radius versus electronegativity most effectively demonstrated that the conditions are: the added oxide must have a cation radius larger than that of tetravalent Zr to be stable down to room temperature, and the added oxide must be somewhat more electropositive than the Zr. This then produces a more nearly ionic lattice for which the fluorite structure would be expected. Furthermore, the added oxide must be di- or trivalent. Random cation placement occurs with divalent cations and ordering is obtained with the trivalent ones. The CaF_2-rare earth oxide systems in a laboratory atmosphere were studied, and ABO_4 type structures were correlated.

1949

Miami U. Dept. of Chemistry, Coral Gables, Fla.

CORRELATING ABO_4 COMPOUND STRUCTURES, by K. S. Vorres. [1961] [10]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-104 and Institute of Gas Technology in Chicago) Unclassified

Abstract published in Eighteenth Internat'l. Cong. Pure and Appl. Chem., Montreal (Canada) (Aug. 1961), Abstracts of Scientific Papers, Toronto U. Press, 1961, p. 73. (Title varies)

Published in Jour. Chem. Education, v. 39: 566-568, Nov. 1962.

The structures of ABO_4 compounds depend on several factors. If A and B are the same, or if A can randomly replace B in the lattice, then one of the MO_2 structures is observed. The structure can usually be predicted on the basis of the cation: anion radius ratio. When A does not randomly replace B, then compound formation is observed. This has been studied systematically in terms of the valences of A and B. Thus these may be classified as IV-IV, III-V, II-VI, or I-VII compounds. The literature has been reviewed and a number of compounds have been prepared and studied to determine the criteria for random replacement or compound formation. These criteria are discussed in terms of similarity of valences, ionic size and non-metal contact distances, coordination number, electronegativity, and polarizability. Predictions are made for the structures of other compounds which have not yet been prepared or studied.

1950

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

SOLUTION OF THE DIRICHLET PROBLEM BY INTERPOLATING HARMONIC POLYNOMIALS, by J. H. Curtiss. [1962] [5]p. (AFOSR-3716) (AF 49(638)862) Unclassified

Also published in Bull. Amer. Math. Soc., v. 68: 333-337, July 1962.

Let D be a simply-connected plane domain and C its boundary. The problem studied is the following: Given boundary data u(z), is it possible to find points z_{mn} $(m = 1, \cdots, 2n + 1, n = 1, 2, \cdots)$ and harmonic polynomials $h_n(z)$ of degree n such that $h_n(z_{mn}) = u(z_{mn})$ and $\lim_{n \to \infty} h_n(z) = U(z)$ $(z \in D)$, where U(z) solves the Dirichlet problem with the given data? It is shown that the answer is in the affirmative in those cases in which there exist harmonic polynomials $H_n(z)$ of order n such that $|u(z) - H_n(z)| = o(n^{-1})$ uniformly on C. (Math. Rev. abstract)

1951

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

EXTENSION PROPERTIES OF BANACH SPACES, by A. Sobczyk. [1962] 11p. incl. refs. (AFOSR-3248) (AF 49(638)1055) AD 450830 Unclassified

Also published in Bull. Amer. Math. Soc., v. 68: 217-224, May 1962.

The equivalence of several properties concerning projections and extensions in Banach space which are seemingly different, is established. The main result is the equivalence of the extension property to the uniform extension property. This is a consequence of the following theorem: If a Banach space B has the property that there is a bounded projection of C onto B, for every Banach space C which is a superspace of B, then there exists a constant K = K(B), independent of C, such that for each superspace C, there is a projection onto B having bound less than or equal to K.

1952

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

TOPOLOGICAL SPACES WITH LESS THAN HAUSDORFF SEPARATION, by A. Sobczyk. [1962] [36]p. incl. refs. (AFOSR-3249) (AF 49(638)1055) AD 428352 Unclassified

An attempt is made to provide a needed foundation for the study of projections in function-spaces on the basis of the following definition: A set **X** is a topological space in case there is a collection of subsets, called open sets, which satisfy the following conditions: (1) any union of open sets is open; (2) any finite intersection of open sets is open; and (3) x and φ are open. As usual, a subset A of X is closed if and only if its complement A' is open. It is proved that there is a resolution of topologies for X into complementary topologies, corresponding to complementary linear subspaces of real-valued continuous functions on X.

1953

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

LINEAR VARIETIES OF PROJECTIONS, by A. Sobczyk. [1962] 17p. (AFOSR-3701) (AF 49(638)1055) Unclassified

A projection in a linear space E is a linear operator P such that $P^2 = P$. If $R \subset E$ is the range of P, since PPx = Px, the projection P is the identity on R. Let N denote the null-space of P. Then I - P is a projection with null-space R, and range N. Each $z \in E$ has a unique representation $z = x + y = Pz + (I - P)z$, $x \in R$, $y \in N$; R and N are called complementary subspaces and uniquely determine the projections P and (I - P). In case 2 projections P, Q in E have a common range, it follows that PQ = Q, QP = P; and in case they have a common null-space, that PQ = P, QP = Q. Conversely, if P and Q are any operators such that PQ = Q, QP = P, then from the first equation, P must be the identity on R (Q), $R(P) \supset R(Q)$, and from the second equation, Q must be the identity on R(P), $R(Q) \supset R(P)$, therefore R(P) = R(Q). Similarly, if P, Q are any linear operators such that PQ = P, QP = Q, it is shown that N(P) = N(Q).

1954

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

PROJECTIONS AND ISOMETRIC SUBSPACES, by A. Sobczyk. [1962] 9p (AF 49(638)1055) Unclassified

It is proved that for any hyperplane M in a space $m(Z_p = R_p$ for any finite set $Z = 1, \ldots, p$, if there is a projection of bound 1 of R_p onto M, then necessarily M is isometric with R_{p-1}. The question is raised does a Banach space B exist which has exact projection constant s, such that for each C B, there is a projection of C onto B of bound less than s? And is there a space B which is universally unique-minimal, i.e., a space B which for every C which contains B, is unique-minimal? The discussion on these questions leads to the derivation of a form for the isometry of M onto R_m.

1955

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

THE SIMPLE DIMENSION OF A TOPOLOGICAL SPACE, by A. Sobczyk. [1962] 12p. (AF 49(638)1055) Unclassified

Denote by C(S) the linear space of all continuous real functions on a topological space S. For any finite dimensional linear subspace N of C(S), if n is the dimension of N, there exist n linearly independent functions $u_1, \ldots, u_n$ of N which form a basis. It is shown that the mapping, φ, on S to Euclidean space E_n, defined by $\varphi(s) = (u_1(s), \ldots, u_n(s))$, is continuous.

1956

Miami U. [Dept. of Physics] Coral Gables, Fla.

AN EXAMPLE OF HYPERFRAGMENT DECAY IN THE π^+ MODE AND OTHER INTERACTIONS OF K^- MESONS AND HYPERONS IN EMULSION, by M. Blau, C. F. Carter, and A. Perlmutter. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-J539) (AF 49(638)97) Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 774-785, Feb. 16, 1963.

A number of interactions of hyperons and K^- mesons with emulsion nuclei are described. In particular, an example of a hyperfragment decaying by the π^- mode and a possible ($\Sigma^+ p$) hyperfragment decay have been observed. Also described are captures of Σ^- hyperons with large energy release, an unusual Σ^- decay, a possible example of $\Sigma^+ \rightarrow n + \gamma$, and certain K^--multinucleon interaction A summary of all known $\Sigma^\pm$ inelastic interactions with nuclei is also included.

1957

Michigan State U., East Lansing.

SOME LIE ADMISSIBLE ALGEBRAS, by P. J. Laufer and M. L. Tomber. [1961] [6]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)511 and National Science Foundation) Unclassified

Published in Canad. Jour. Math., v. 14: 287-292, 1962.

A study is presented of algebras which are related to Lie algebras in that they satisfy some of the identities of a Lie algebra and are also Lie admissible. An example of such a generalization is a flexible algebra satisfying $x(yz) + y(zx) + z(xy) = 0$ and $(xy)z + (yz)x + (zx)y = 0$. Such an algebra is both Lie admissible and Jordan admissible. The 2 major theorems are concerned with a more general class than that determined by the above identities. Let $\mathfrak{A}$ be a flexible, Lie admissible algebra over an arbitrary algebraically closed field Ω of characteristic 0. It is proved that if $\mathfrak{A}^{(-)}$ is a semi-simple Lie algebra, then $\mathfrak{A}$ is a direct sum of simple, flexible, Lie admissible algebras. Under the same hypotheses, if $\mathfrak{A}^{(-)}$ is a simple Lie algebra, then $\mathfrak{A}$ is a simple Lie algebra isomorphic to $\mathfrak{A}^{(-)}$.

1958

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

TRANSPORT PROPERTIES IN DILUTE ALLOYS, by F. J. Blatt. [1962] [17]p. incl. refs. (AFOSR-3737) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)70 and National Science Foundation) AD 288520 Unclassified

Also published in Metallic Solid Solutions; A Symposium on their Electronic and Atomic Structure, Orsay (France) (July 9-11, 1962), ed. by J. Friedel and A. Guinier. W. A. Benjamin, Inc., 1963, p. II-1—II-11.

Also published in Jour. Phys. et Radium (Paris), v. 23: 597-601, Oct. 1962.

Recent theoretical and experimental progress relating to transport properties in dilute alloys is reviewed, with particular attention paid to the value of conventional transport measurements in providing information on the electronic band structure of alloys. (Contractor's abstract)

1959

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

THEORY OF ELECTRON CONDUCTION IN STRONG MAGNETIC FIELDS AT LOW TEMPERATURES, by K. Nakamura. Oct. 1962, 14p. (AFOSR-3906) (AF 49-(638)70) AD 287464 Unclassified

An approach for the study of electron conduction in strong magnetic fields is developed and the thermopowers of metals are calculated. The final results will be obtained in the near future. It is expected that in transverse conduction the dependence of thermopower upon magnetic field will be significantly changed by the presence of phonon drag. On the other hand, the effect of phonon drag in longitudinal conduction will be smaller, compared with that in transverse conduction.

1960

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

ANTIFERROMAGNETIC RESONANCE AT HIGH MICROWAVE POWER (Abstract), by H. Van Till and J. A. Cowen. [1962] [1]p. [AF 49(638)613] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 449, Aug. 27, 1962.

Several new phenomena have been observed in the magnetic resonance in $CuCl_2 \cdot 2H_2O$ in the antiferromagnetic state at high microwave power. These include: (1) A shift in the antiferromagnetic-resonance position with increasing microwave magnetic field h_1 which terminates in a discrete "jump" of the resonance line to some other position. (2) A complex shift, with increasing h_1 in the fine-structure lines which appear on the larger line. Some lines appear to shift more rapidly than others and the line shapes change. (3) A change in position and amplitude of the proton magnetic resonance during the antiferromagnetic-resonance shift. (4) The transient appearance of a resonance at approximately $H/2$ when the antiferromagnetic resonance line has first undergone a discrete jump. The experiments were performed at 9.4 kmc, at temperatures near 1.2°K. The onset of the effect was observed at microwave powers of approximately 5 mW with cavity Q's of 3000. Although the theoretical interpretation has not been carried out, it appears that these phenomena are related to the critical field discussed in detail by Suhl for ferromagnetic resonance in ferrites.

1961

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

EFFECT OF ISOTOPIC COMPOSITION ON SOLID STATE SPECTRA (Abstract), by D. J. Montgomery, W. B. Zimmerman, and R. H. Misho. [1962] [1]p. (AFOSR-3557) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)622 and Atomic Energy Commission) Unclassified

Presented at Internat'l. Symposium on Far Infrared Spectroscopy, Cincinnati, Ohio, Aug. 21-24, 1962.

A study was made of the infrared spectrum in the region of the dispersion wavelength, λ_0, for thin films of lithium fluoride ($\lambda_0 \sim 30\mu$) made with varying

proportions of Li^6 and Li^7, and for thin films of lithium hydride ($\lambda_0 \sim 20\mu$) made with varying proportions of Li^6 and Li^7, H^1 and H^2. The position of the principal absorption peak and its half-width were studied as a function of isotopic composition, film thickness, and temperature. Although some of the main features of the curves can be explained on the simple Born-Huang approach, the details show that a more powerful treatment is necessary. Some preliminary work is described on samples prepared by methods other than evaporation of films on various substrates.

1962

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

ON THE ANALYSIS OF SPECTRA IN TRANSMISSION THROUGH THIN FILMS, by D. J. Montgomery and K. F. Yeung. [1962] [24]p. incl. diagrs. tables, refs. (AFOSR-3748) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)622 and Atomic Energy Commission) AD 405514 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1056-1061, Sept. 1, 1962.

A technique to investigate the adequacy of the damped harmonic-oscillator model for infrared absorption in thin films is described, together with a simple procedure for extracting the material parameters and the film thickness from the transmission curve. The methods are illustrated by application to several ionic crystals. (Contractor's abstract)

1963

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

EFFECT OF ISOTOPIC COMPOSITION ON SOLID STATE SPECTRA, by D. J. Montgomery, W. B. Zimmerman, and R. H. Misho. [1962] [34]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)622] and Atomic Energy Commission) Unclassified

Presented at Internat'l. Symposium on Far Infrared Spectroscopy, Cincinnati, Ohio, Aug. 21-24, 1962.

For abstract see item no. 1961, Vol. VI.

1964

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

[INFRARED AND MICROWAVE ROTATION OF ASYMMETRIC TOP MOLECULES] by P. M. Parker. Interim final rept. June 1, 1960-May 31, 1962. Oct. 11, 1962 [2]p. (AFOSR-4042) (AF 49(638)894) Unclassified

This report summarizes the achievements obtained from the application of the energy moment method to theoretical analysis of infrared and microwave rotation of asymmetric top molecules. The publications which resulted from this research are listed.

1965

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

SYMMETRY PROPERTIES OF THE ASYMMETRIC-ROTATOR CENTRIFUGAL-DISTORTION CONSTANTS, by P. M. Parker. [1962] [4]p. incl. tables, refs. (AFOSR-J135) (AF 49(638)894) AD 400186 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1596-1599, Oct. 15, 1962.

The symmetry properties of the first-order centrifugal-distortion Hamiltonian for the asymmetric rotator have been studied. The number of independent distortion constants needed to interpret centrifugal-distortion effects in microwave and infrared spectra of asymmetric top molecules is determined for the asymmetric-rotator point groups and a number of relationships existing between these constants is given. (Contractor's abstract)

1966

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

COMPUTATION OF ASYMMETRIC ROTATOR CONSTANTS FROM ENERGY MOMENTS. IV, by V. A. Genusa and P. M. Parker. [1962] [4]p. incl. tables. (AFOSR-J144) (AF AFOSR-62-375) AD 400378 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2615-2618, Dec. 1, 1962.

The energy-moment procedure is used to develop expressions which are helpful for the analysis of centrifugal distortion effects in asymmetric top spectra. In principle, all first-order distordon constants can be evaluated if a sufficient number of transition frequencies are available from experiment. (Contractor's abstract)

1967

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

ASYMMETRIC-TOP VIBRATION-ROTATION HAMILTONIANS, by K. T. Chung and P. M. Parker. [1962] [10]p. incl. tables, refs. (AFOSR-J505) ((AF AFOSR-62-375) AD 407876 Unclassified

Also published in Jour. Chem. Phys., v. 38: 8-17, Jan. 1, 1963.

From the general molecular vibration-rotation Hamiltonian in the Nielsen-Amat-Goldsmith formulation, Hamiltonians for asymmetric-top molecules of the orthorhombic, monoclinic, and triclinic point group

symmetries are deduced. These Hamiltonians are appropriate for the calculation of vibration-rotation energies to the fourth order of approximation.

1968

Michigan U. [Acoustics and Seismics Lab.] Ann Arbor.

AZIMUTHAL ASYMMETRY OF A POINT SOURCE IN A CYLINDRICAL LOW VELOCITY MEDIUM, by W. C. Meecham and J. DeNoyer. [1961] [6]p. incl. diagrs. (AF 49(638)911) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 52: 139-144, Jan. 1962.

The geometry of the medium in the vicinity of an otherwise symmetrical source is shown to produce a frequency dependent variation of amplitude with azimuth. The model considered is a cylindrical low velocity and low density fluid medium that is contained in a full space of a higher velocity and density fluid material. A simple harmonic point source is located on the axis of the cylinder. Amplitudes in the higher velocity medium at large distances from the source are found to be functions of the velocity ratio and the density ratio of the 2 media, the radius of the cylinder, the wavelength, and the angle between the axis of the cylinder and a line connecting the point of observation with the source.

1969

Michigan U. Acoustics and Seismics Lab., Ann Arbor.

EFFECTS OF DECOUPLING ON SPECTRA OF SEISMIC WAVES, by D. E. Willis and J. T. Wilson. [1961] [9]p. incl. diagrs. table. (AF 49(638)911) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 52: 123-131, Jan. 1962.

A series of controlled high explosive shots were conducted by the Atomic Energy Commission in a salt mine near Winnfield, La., to investigate seismic decoupling theories. Two recording stations were used by the University of Michigan at various distances between 1.1 and 14.7 km for a majority of these shots. Frequency analyses of the magnetic tape recordings were made and the results are presented showing the relationship of the frequency spectra as a function of charge size, distance from the source, and coupled vs decoupled shots. The smaller decoupled shots detonated in the large spherical cavities were observed to have somewhat higher predominate frequencies than the equivalent size coupled shots. A change in cavity size produced no significant difference in the shape of the spectra of the large decoupled shots.

1970

Michigan U. [Acoustics and Seismics Lab.] Ann Arbor.

A NOTE ON THE EFFECT OF RIPPLE FIRING ON THE SPECTRA OF QUARRY SHOTS, by D. E. Willis. [1962] [7]p. incl. diagrs. (Sponsored jointly by Air Force Cambridge Research Labs., and Air Force Office of Scientific Research under AF 49(638)911) AD 405004 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 79-85, Jan. 1963.

A series of controlled quarry shots were recorded at a distance of approx 900 ft to ascertain the effect of ripple firing on amplitude and spectra of the seismic waves. A measurable reduction in the amplitude of compressional and shear waves was observed at some frequencies. This effect was not so pronounced for the surface waves. (Contractor's abstract)

1971

Michigan U. [Acoustics and Seismics Lab.] Ann Arbor.

OBSERVED ASYMMETRY OF AMPLITUDES FROM A HIGH EXPLOSIVE SOURCE, by J. DeNoyer, D. E. Willis, and J. T. Wilson. [1961] [5]p. incl. diagrs. table. (AF 49(638)911) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 52: 133-137, Jan. 1962.

Frequency analysis of seismic magnetic tape records from a 500-ton high-explosive source shows a pronounced variation of amplitude with frequency for 2 different azimuths from the source. This amplitude variation is attributed, at least in part, to diffraction effects produced by the geologic structure in the vicinity of the source. The possibility of generating both SV and SH waves from P waves within this structure seems very probable.

1972

Michigan U. Acoustics and Seismics Lab., Ann Arbor.

THE SPECTRUM OF SEISMIC NOISE, by G. E. Frantti, D. E. Willis, and J. T. Wilson. [1961] [9]p. incl. illus. diagrs. table. (AF 49(638)911) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 52: 113-121, Jan. 1962.

The seismic noise spectrum in the frequency range 0.5 to 31.5 c/sec is presented graphically for a number of sites over a wide geographical range. Except for a small anomalous effect near 2 or 3 c/sec, the ground particle motion curves are observed to decrease smoothly with increasing frequency at a rate approximately proportional to the second power of frequency. The curves steepen at frequencies below 1 c/sec.

1973

Michigan U. Acoustics and Seismics Lab., Ann Arbor.

SIGNAL ENHANCEMENT THROUGH AN ENSEMBLE PRESENTATION, by P. L. Jackson. [1962] [7]p. incl. illus. diagrs. (AFOSR-2433) (AF 49(638)1078) Unclassified

Also published in Bull. Seismol Soc. Amer., v. 53: 585-591, Apr. 1963.

A method of treating array responses is presented. The entire statistical distribution from the array is used for either direct visual estimation, or for processing in a scanning machine. An estimate of a coherent signal and the character of the noise can be made visually. Most correlative techniques, in addition to digitizing, could be performed simultaneously through using the scanning machine. (Contractor's abstract)

1974

Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor.

SOME FEATURES OF STABILITY OF LAMINAR FLOWS AND OF TRANSITION TO TURBULENCE, by A. M. Kuethe. [1962] [12]p. incl. diagrs. table, refs. (AFOSR-3648) (AF 49(638)336 and AF 18(603)34) Unclassified

Also published in Miszellaneen der Angewandten Mechanik, by W. Tollmien. Berlin, Akademie-Verlag, 1962, p. 154-165.

Experiments are conducted on the character of small disturbances in Poiseuille flow in a tube and in a stable boundary layer on a sphere. Investigation is also undertaken on the transition process in the tube flow. Results are discussed and the following conclusions are reached: (1) the threshold disturbance for transition in fully developed Poiseuille flow in a tube decreases with increasing Reynolds number, (2) in fully developed Poiseuille flow in a tube and in a stable boundary layer, there exist many stable disturbance modes, (3) the details of the transition process are strongly dependent on the nature of the disturbance generated, (4) when the disturbance generator is placed in the laminar flow away from the wall, the maximum value of the high shearing stresses measured at the wall depends on the radial distance from the disturbance generator to the wall, and (5) the measurements provide some clues to the cause of the high rate of heat transfer and high recovery factor occurring in the transition region in high speed flow.

1975

Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor.

IGNITION TIME DELAY OF HYDROGEN-OXYGEN-DILUENT MIXTURES AT HIGH TEMPERATURES, by J. A. Nicholls, T. C. Adamson, Jr., and E. B Morrison. [1962] [5]p. incl. diagrs. table, refs. (AF 49(638)562) Unclassified

Published in AIAA Jour., v. 1: 2253-2257, Oct. 1963.

The motivation for this study arose from experiments on standing detonation waves wherein the flame front was visibly separated from the shock front. This physical separation corresponds to the ignition time delay. A theoretical analysis of the ignition time delay zone for hydrogen-oxygen-diluent mixtures is presented herein. A reaction scheme consisting of 9 reactions, which should be valid for temperatures above about 1100°K, is considered. Assuming the initial mol fractions of H_2 and O_2 to be of order unity and taking advantage of inequalities that should be valid to at least 2000°K, it is possible to integrate the differential equations representing the kinetics. Thus time dependent expressions for all radical and water vapor concentrations behind the shock wave are obtained. A characteristic time, based on the initial concentration of H_2 and the fastest reaction rate constant, is introduced. For times much greater than this characteristic time, the equations reduce to very simple forms. In order to arrive at an explicit analytical expression for the ignition time delay, a value for the mol fraction of H, characteristic of this delay time, is introduced. It is found that the delay time is dependent on the temperature, pressure, composition, and reaction rate constant for the rate controlling reaction. There is weak dependence on the reaction rate constants for the initiation reactions. A brief comparison between this theory and some experimental results on standing detonation wa[illegible]s presented and good agreement found. The theory is also in good agreement with available shock tube results.

1976

Michigan U. [Dept. of Aeronautical and Astronautical Engineering] Ann Arbor.

STANDING DETONATION WAVES, by J. A. Nicholls. [1962] [11]p. incl. illus. diagrs. refs. (AF 49(638)562) Unclassified

Published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 488-498.

It is the purpose of this paper to examine the reported results on standing detonation waves as obtained in different facilities and compare them. Comparison is also made with results obtained from shock tubes and a ballistic range. Towards this end consideration is given to the ignition delay period, the effects of vibrational relaxation, and the importance of 2-dimensional effects. (Contractor's abstract, modified)

1977

Michigan U. Dept. of Astronomy, Ann Arbor.

ABUNDANCES OF ELEMENTS IN STARS AND NEBULAE (STUDIES OF HYDROGEN-DEFICIENT STARS: I), by L. H. Aller. June 1962, 41p. incl. diagrs. tables, refs. (Technical note no. 1) (AFOSR-2954) (AF 49(638)807) AD 282369 Unclassified

In order to interpret the spectrum of a star composed primarily of helium rather than of hydrogen, it is necessary to construct a model atmosphere which gives the variation of pressure temperature and density with depth. On the assumption that the atmosphere is in hydrostatic equilibrium and that flow of energy takes place by radiation rather than by convection currents, the calculation of an appropriate model is described. The essential boundary condition that the radiative flux is constant with depth can be applied only after temperature and pressure have been calculated for all different depths and the entire radiation field has been calculated. Hence an iterative process has to be applied. Procedures which work for the corresponding problem of a hydrogen atmosphere fail, and one must proceed by trial and error in order to obtain the final solution. (Contractor's abstract)

1978

Michigan U. Dept. of Astronomy, Ann Arbor.

ABUNDANCES OF ELEMENTS IN STARS AND NEBULAE (THE ABUNDANCE OF CERTAIN ELEMENTS IN THE SOLAR ATMOSPHERE), by L. H. Aller. June 1962, 28p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-3024) (AF 49(638)807) AD 282368 Unclassified

The solar abundances of 21 elements (Na, Sc, Cu, Zn, Ga, Ge, Sr, Y, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Ba, and Yb) were revised with the aid of new gf values obtained by C. Corliss. Some implications of the new measurements are discussed and it is emphasized that a comprehensive reconsideration of solar abundances should be undertaken, in which ions as well as neutral atoms and a new model solar atmosphere are used. (Contractor's abstract)

1979

Michigan U. [Dept. of Astronomy] Ann Arbor.

A SEARCH FOR Ba II STARS, by A. P. Cowley and C. R. Cowley. [1962] [3]p. incl. diagr. table. (AFOSR-3087) (AF 49(638)807) AD 450842 Unclassified

Also published in Publ. Astronom. Soc. Pacific, v. 74: 79-81, Feb. 1962.

In this preliminary survey of plates taken with the 10° objective prism of the 24-26 in. Curtis Schmidt of the University of Michigan, it was found that due to the crowding of metallic lines in the region of the λ-4554 Ba II resonance line, a higher dispersion than 110 A°/mm at Hγ was needed to be able to definitely class certain stars of the B II type as K giants. These stars differed most from normal K giants in the abnormal strength of Sr II 4077 and 4216. The stars previously classified as KO are thus assigned tentatively to a peculiar K-star category.

1980

Michigan U. Dept. of Astronomy, Ann Arbor.

ABUNDANCES OF ELEMENTS IN STARS AND NEBULAE (SPECTRAL LINE STRENGTHS FROM ASTROPHYSICAL DATA), by L. H. Aller, July 1962, 29p. incl. diagrs tables. refs. (Technical note no. 3) (AFOSR-3432) (AF 49(638)807) AD 612193 Unclassified

An attempt is made to compile empirical log (gf λ's) for lines of metallic ions of FeII, FeIII, CrII, TiII, and MnII. Here f is the Landenburg f, or oscillator strength, g is the statistical weight of the lower level, and λ is the wavelength of the line. The curve of growth relates the equivalent width of a spectral line to the number of atoms capable of absorbing it and to the f-value of the transition involved. If the electron pressure and temperature in the stellar atmosphere are known, relative log gf λ's can be determined. Furthermore, if laboratory absolute gf's are available for a few of these lines, then relative gf λ's can all be converted to absolute gf λ's. The advantages and limitations of these astrophysical gf's are described, and it is emphasized that in order to secure adequate line strength data, one must (a) secure good line-intensity data (b) interpret these with the aid of a model atmosphere, taking into account effects of the stratification in the atmosphere. The gf λ-values herein tabulated may be useful in analyzing the spectra of incandescent gases in laboratory or experimental sources of unknown temperature and pressure. (Contractor s abstract)

1981

Michigan U. Dept. of Astronomy, Ann Arbor.

ABUNDANCES OF ELEMENTS IN STARS AND NEBULAE (DETERMINATION OF RATIO OF GAS PRESSURE TO ELECTRON PRESSURE IN STELLAR ATMOSPHERES), by C. [R.] Cowley, A. [P.] Cowley, and L. H. Aller. July 1962, 10p. incl. diagrs. tables. (Technical note no. 4) (AFOSR-3433) (AF 49(638)807) AD 612182 Unclassified

The ratio of gas pressure to electron pressure has been computed over a range of temperatures by an approximate method and also by a more exact IBM 709 program. The approximate method shows large errors at low temperatures and high gas pressures. Tables give the values of log P_g and log P_e computed by the 709 as well as the relative abundances to which these values refer. (Contractor's abstract)

1982

Michigan U. Dept. of Astronomy, Ann Arbor.

ABUNDANCES OF ELEMENTS IN STARS AND NEBULAE (THE MANGANESE STAR 53 TAURI), by L. H. Aller and W. P. Bidelman. July 1962, 42p. incl. illus. diagrs. tables, refs. (Technical note no. 5) (AFOSR-3434) (AF 49(638)807) AD 612183 Unclassified

Presented at meeting of the Amer. Astronom. Soc., New Haven, Conn., Aug. 26-29, 1962.

Abstract published in Astronom. Jour., v. 67: 571, Nov. 1962. (Title varies)

The chemical composition of the Manganese star 53 Tauri was studied. Transition probabilities required for the problem are obtained from laboratory sources whenever possible, but some are obtained by the calibration of stellar data. The temperature of the star, deduced from ionization equilibrium, is near 11,000°K-a value in good agreement with that found from spectral energy scans by Jugaku and Sargent. The electron pressure in the atmosphere, deduced from the total intensities of hydrogen lines, appears to lie in the neighborhood of 500 dynes cm^{-2}. Several striking abundance anomalies are found; they cannot be explained by deviations from local thermodynamic equilibrium. Manganese seems to be the most abundant metal in the star, but gallium appears to show the greatest enhancement of abundance over the normal value. Strontium, yttrium, and zirconium are also enhanced in abundance, while manganese, and calcium seems to be depleted. (Contractor's abstract)

1983

Michigan U. Dept. of Astronomy, Ann Arbor.

ABUNDANCES OF ELEMENTS IN STARS AND NEBULAE, by L. H. Aller. Final rept. Aug. 1961-Aug. 1962, Sept. 1962, 141p. incl. illus. diagrs. tables, refs. (AFOSR-4234) (AF 49(638)807) AD 292680 Unclassified

Data are given from investigations undertaken on the following subjects: (1) energy distribution in globular star clusters; (2) spectrophotometry of the Wolf-Rayet star of γ_2 velorum; (3) the hydrogen/helium ratio in HD 96446; (4) the emission nebulosities in the large magellanic cloud; (5) emission nebulosities in the small magellanic cloud; and (6) photographic region of the spectrum of NGC 7009.

1984

Michigan U. [Dept. of Astronomy] Ann Arbor.

REVISED ABUNDANCES OF SOME METALS IN THE SUN (Abstract), by L. H. Aller. [1962] [1]p. [AF 49-(638)807] Unclassified

Presented at 111th meeting of the Amer. Astronom. Soc., Yale U., New Haven, Conn., Aug. 26-29, 1962.

Published in Astronom. Jour., v. 67: 571, Nov. 1962.

Approximate f values for a large number of metallic lines in a copper arc have been measured, thus providing a large body of homogeneous data for many transitions of neutral atoms and ions that are of astrophysical interest. These transitions probabilities have been used in conjunction with a previously published model atmosphere to derive new estimates of the abundances of certain metals.

1985

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

SINTERING OF ZINC OXIDE, by L. F. Norris and G. Parravano. [1962] [4]p. incl. diagrs. (AFOSR-1361) (AF 49(638)493) AD 438298 Unclassified

Also published in Jour. Amer. Ceram. Soc., v. 46: 449-452, Sept. 1963.

Sintering studies have been conducted with single crystal spheres of zinc oxide in air at total pressures of 10^{-3} to 1.0 atm over the range 1050° to 1250°C. Quantitative observations were made on the rate of growth of a neck between the spheres. No change in the distance between the geometrical centers of the spheres was observed. An analysis of the kinetic data shows that sintering was predominantly achieved by distillation through the surrounding gas phase. At 1150° the rate of welding was inversely influenced by the total pressure when the latter was changed from 0.003 to 0.75 atm. No conclusion could be reached on the effect of the oxygen partial pressure at constant total pressure. A brief summary of the various sintering mechanisms of zinc oxide from 700° to 1250°C is presented. (Contractor's abstract)

1986

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

KINETICS OF SINTERING OF RUTILE SINGLE CRYSTAL SPHERES, by H. M. O'Bryan, Jr. and G. Parravano. July 1962, 33p. incl. illus. diagrs. tables, refs. (Rept. no. 02832-15-T) (AFOSR-2763) (AF 49(638)493) AD 282373 Unclassified

The sintering of single crystal rutile has been studied in air and in reducing atmosphere in the temperature range 900° to 1350°C using a sphere-to-sphere model. Rate data show that there are 2 sintering periods: a slow initial growth characterized by a rate exponent n = 7 and a more rapid subsequent period n = 2. The development of flat surfaces or facets on the particles is used to explain the 2 periods. A scaling exponent of 3 and an activation energy of 70 kcal/mol indicate that volume diffusion is the sintering mechanism. The initial rate exponent cannot be explained. Increase sinterability of reduced rutile is explained by the defect structure. Facet formation on rutile spheres is discussed. (Contractor's abstract)

1987

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

THE STIRRED-FLOW REACTOR IN HETEROGENEOUS CATALYSIS, by G. Parravano. Final rept. Dec. 1962, 5p. (AFOSR-4410) (AF 49(638)506) AD 400053 Unclassified

This research was devoted to the study of those chemical reacting systems which are of interest for furthering

present understanding of the mechanism of heterogeneous catalysis. A thorough search of several catalytic reactions was undertaken. Isomerization of hydrocarbons, polymerization of vinyl monomers, oxidation of CO, decomposition of nitrous oxide, and electrochemical polymerization reactions were investigated to find the experimental conditions (nature of catalyst, concentration of reagents, temperature and contact time) most suitable for stirred-flow operation. The results suggest that the application of the stirred-flowed technique to heterogeneous catalysis has value for assuring uniformity of catalyst composition and polymer produced, and, in addition, has great value for use in complex reactions and for the comparison of results obtained on catalyst samples, which differ in a characteristic property of the solid state (electrical, magnetic effects).

1988

Michigan U. [Dept. of Physics] Ann Arbor.

FURTHER STUDIES OF Cr I EMISSION FROM THE SHOCK TUBE, by G. Charatis and T. D. Wilkerson. [1962] [2]p. incl. table, refs. [AF 49(638)439] Unclassified

Published in Phys. Fluids, v. 5: 1661-1662, Dec. 1962.

Previous results showing anomalous excitation temperatures of Cr I lines in reflected shocks are now attributed to an error in the gf values obtained by Hill and King. New work on relative intensities of Cr I and Cr II lines and line-reversal measurements are consistent with equilibrium in shocks at 6600° to 9600°K if the gf values are adjusted.

1989

Michigan U. Dept. of Psychology, Ann Arbor.

AN INFORMATIONAL APPROACH TO THINKING, by M. I. Posner. Apr. 1962, 177p. incl. diagrs. tables. refs. (Rept. no. 02814-9-T) (AFOSR-2635) (AF 49-(638)449) AD 276136 Unclassified

The general hypothesis of this thesis is that the amount of reduction of information from input to output is an important factor in the amount of thinking required by the task. This applies only to tasks which require the subject to process the input so that it is represented in a reduced form in the response. The hypothesis leads to the prediction that the greater the amount of information reduction involved in a task the greater the length of time to accomplish it, the more errors, the greater the variability over subjects, and the longer the learning time. The possibility of specifying the amount of thinking required by a psychological task is demonstrated. Within a given task configuration the information reduction measure provides accurate prediction of human performance. It provides a base line useful in the comparison of performance among different types of tasks and in the classification of tasks. (Contractor's abstract)

1990

Michigan U. [Dept. of Psychology] Ann Arbor.

COMMUNICATIONS AND DECISION PROCESSES AS DETERMINANTS OF ORGANIZATIONAL EFFECTIVENESS. REPORT OF A FIELD EXPERIMENT, by S. E. Seashore and D. G. Bowers. Final rept. Mar. 1962, 141p. incl. diagrs. tables. (AFOSR-2553) (AF 49(638)-1032) AD 275894 Unclassified

A field experiment was conducted to increase in certain departments of an industrial firm: (1) group-oriented activity, (2) mutual interaction and influence within work groups, (3) supervisory supportiveness in relation to subordinates, and (4) amount of decision-making activity by subordinates. These changes were successfully introduced in 3 experimental departments in comparison with 2 control departments. The effects were to increase machine efficiency, and to increase employee satisfactions. Waste performance improved in both experimental and control departments. Absence rates rose overall, but less in the experimental than in the control departments. (Contractor's abstract)

1991

Michigan U. [Dept. of Psychology] Ann Arbor.

SUPERVISORY METHODS AND GROUP PERFORMANCE NORMS, by M. Patchen. Mar. 1962 [29]p. incl. tables. (AFOSR-2554) (AF 49(638)1032) AD 281261 Unclassified

Also published in Admin. Sci. Quart., v. 7: 275-294, Dec. 1962.

Some of the determinants of group performance norms in an industrial firm are examined. Encouragement of efficiency by the foreman is shown to be effective only when the supervisor also attempts to obtain rewards for subordinates—and vice-versa. Close supervision is found, in seeming contradiction to previous studies, to facilitate high performance norms. Reward for efficiency and strong group cohesiveness have the best effects when supervision is close. The conditions under which close supervision can be effective and when it is ineffective are discussed. When the supervisor shows an interest in the work and is not indifferent, the subordinates are eager to please him. "Close supervision" is defined operationally as primarily frequent checking on subordinates' work, and not reducing their freedom to do the work in their own way.

1992

Michigan U. [Dept. of Psychology] Ann Arbor.

SELF-ESTEEM AND THE DIFFUSION OF LEADERSHIP STYLE, by D. G. Bowers. Mar. 1962 [18]p. incl. refs. (AFOSR-2555) (AF 49(638)1032) AD 276702 Unclassified

Also published in Jour. Appl. Psychol., v. 47: 135-140, Apr. 1963.

This study suggests that conflicting evidence concerning leadership climate may be reconciled by postulating intervening cognitive processes. One such cognitive process, the self-esteem of the lower-level supervisor, is studied in the context of an organization in which no formal human relations training had taken place. A series of hypotheses relate supportiveness of the foreman's supervisor to the foreman's self-esteem, and its attendant consequences, and the latter to the foreman's behavior toward his subordinates. All hypotheses are confirmed and lend strong support of the proposition that evidence for leadership climate can be obtained ordinarily only by taking into account the motivational and cognitive structures which exist at the levels of organization being studied. (Contractor's abstract)

1993

Michigan U. Engineering Psychology Group, Ann Arbor.

DYNAMIC DECISION THEORY AND PROBABILISTIC INFORMATION PROCESSING, by W. Edwards. [1961] [39]p. incl. diagr. refs. (AFOSR-1402) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)769 and Operational Applications Lab.) Unclassified

Presented at Human Factors Soc. Conf., Columbus, Ohio, Sept. 13-15, 1961.

The development of a dynamic decision theory will be central to the impending rapid expansion of research on human decision processes. Out of a taxonomy of 6 kinds of decision problems, 5 require a dynamic theory in which the decision maker is assumed to make a sequence of decisions, basing decision n + 1 on what he learned from decision n and its consequences. Research in progress on information seeking, intuitive statistics, sequential prediction, and Bayesian information processing is reviewed to illustrate the kind of work needed. The relevance of mathematical developments in dynamic programming and Bayesian statistics to dynamic decision theory is examined. A man-computer system for probabilistic processing of fallible military information is discussed in some detail as an application of these ideas and as a setting and motivator for future research on human information processing and decision making. (Contractor's abstract)

1994

Michigan U. [Engineering Psychology Group] Ann Arbor.

BAYESIAN STATISTICAL INFERENCE FOR PSYCHOLOGICAL RESEARCH, by W. Edwards, H. Lindman, and L. J. Savage. Jan. 1962 [50]p. incl. diagrs. tables, refs. (AFOSR-2009) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)769 and AF AFOSR-62-182, Office of Naval Research, and Operational Applications Lab.) Unclassified

Also published in Psychol. Rev., v. 70: 193-242, May 1963.

Bayesian statistics, a currently controversial viewpoint concerning statistical inference, is based on a definition of probability as a particular measure of the opinions of ideally consistent people. Statistical inference is modification of these opinions in the light of evidence, and Bayes' theorem specifies how such modifications should be made. The tools of Bayesian statistics include the theory of specific distributions and the principle of stable estimation, which specifies when actual prior opinions may be satisfactorily approximated by a uniform distribution. A common feature of many classical significance tests is that a sharp null hypothesis is compared with a diffuse alternative hypothesis. Often evidence which, for a Bayesian statistician, strikingly supports the null hypothesis leads to rejection of that hypothesis by standard classical procedures. The likelihood principle emphasized in Bayesian statistics implies, among other things, that the rules governing when data collection stops are irrelevant to data interpretation. It is entirely appropriate to collect data until a point has been proven or disproven, or until the data collector runs out of time, money, or patience. (Contractor's abstract)

1995

Michigan U. [Engineering Research Inst.] Ann Arbor.

LOW TEMPERATURE HEAT CAPACITY AND THERMODYNAMIC PROPERTIES OF ZINC FERRITE, by E. F. Westrum, Jr. and D. M. Grimes. [1957] [6]p. incl. diagrs. tables, refs. (AFOSR-3575) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)8 and Signal Corps) Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 3: 44-49, 1957.

The heat capacity of zinc ferrite has been determined over the range 5°-350°K. Molal values of C_p, S^0, and $H^0-H_0^0$ computed from the thermal data are 32.99 ± 0.03 cal/deg, 36.01 ± 0.03 cal/deg, and 5369.8 cal, respectively at 298.15°K. A co-operative thermal anomaly associated with antiferromagnetic ordering occurs at 9.5° and extends toward higher temperatures probably as a consequence of persisting short range order. (Contractor's abstract)

1996

Michigan U. Engineering Research Inst., Ann Arbor.

LOW-TEMPERATURE HEAT CAPACITIES AND THERMODYNAMIC PROPERTIES OF ZINC FERRITES-II. EFFECT OF THERMAL HISTORY AND METALLIC ADDITIVES, by E. F. Westrum, Jr. and D. M. Grimes. [1958] [7]p. incl. diagrs. tables, refs. (AFOSR-3576) (AF 18(603)8) Unclassified

Presented in part at Conf. on Magnetism and Magnetic Materials, Washington, D. C., Nov. 1957.

Also published in Jour. Phys. and Chem. Solids, v. 6: 280-286, 1958.

For abstract see item no. MIC. 11:007, Vol. II.

1997

Michigan U. [Engineering Research Inst.] Ann Arbor.

LOW-TEMPERATURE HEAT CAPACITIES AND THERMODYNAMIC PROPERTIES OF ZINC FERRITES. III. EFFECT OF COPPER SUBSTITUTION, by D. M. Grimes and E. F. Westrum, Jr. Jan. 1959, 17p. incl. diagrs. tables. (Technical rept. no. 6) (AFOSR-J519) (AF 18(603)8) AD 414055 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 10: 120-125, July 1959.

For abstract see item no. MIC.11:005, Vol. II

1998

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. VII. SOME EFFECTS OF EXTRANEOUS SOUND AND MANIFEST ANXIETY ON DISCRIMINATION BEHAVIOR, by D. D. Dorfman, A. Platz, and R. B. Zajonc. Mar 1962, 20p. incl. diagrs. tables, refs. (Technical rept. no. 17) (AFOSR-2546) (AF 49(638)367) Unclassified

The present research was designed to test some implications of the hypothesis that the effective or perceived intensity of a stimulus is a function of drive (D) and physical stimulus intensity (S). Implications were derived for discrimination behavior using Spence's transposition model. Four stimulus-drive combinations consisting of either of 2 mild tactual stimuli paired with either of 2 sound intensities were presented to 48 S_S under conditions of successive discrimination-training. All S_S were consistently reinforced for emitting one response to a weak tactual stimulus and a second response to a stronger tactual stimulus. One group of S_S was reinforced only when the concomitant drive was low, and another group when the drive was high. Within each group, there were 4 subgroups, each with a different range of sound intensity. The results confirmed the following implications of the hypothesis: (1) Increase in drive from level of reinforcement reduced the percentage of correct responses to the weaker stimulus and increased it to the stronger; and (2) Decrease in drive from the level of reinforcement reduced the percentage of correct responses to the stronger stimulus and increased it to the weaker. Division of the subjects on the basis of Manifest-Anxiety scores revealed that these effects were larger for low- than for high-anxiety subjects. (Contractor's abstract)

1999

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. VIII. STIMULUS GENERALIZATION AS A FUNCTION OF DRIVE SHIFT, by D. V. Cross and R. B. Zajonc. Apr. 1962, 14p. incl. diagrs. tables. (Technical rept. no. 18) (AFOSR-2556) (AF 49(638)367) Unclassified

A number of recent experiments examined the hypothesis that the perceived stimulus intensity (S') is an increasing function of the physical stimulus intensity (S) and momentary drive (D) level. This hypothesis together with the assumption that response strength is not a function of $_SH_R$ but $_{S'}H_R$, led to implications concerning the effects of drive on stimulus generalization. It predicts, that when drive level is shifted from training to testing, the resulting change in the perceived stimulus intensity (S') will result in a lateral shift of the stimulus generalization gradient. Twelve male pigeons, deprived of food until their body weights were 80% of their free-feeding level, were utilized to test the implications of the drive-stimulus interaction hypothesis. Hunger served to manipulate drive level and circles of differing sizes were used for the stimulus dimension. The results demonstrated that a displacement of the gradients occurred as a consequence of drive shift. However, in contrast to previous studies, increase in drive level produced shifts of the generalization gradients toward stimuli of greater intensities, and decrease in drive toward stimuli of smaller intensities.

2000

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES IN SELECTION LEARNING. V. FACILITATION AND INHIBITION IN SELECTION LEARNING, by S. A. Karabenick. May 1962, 25p. incl. diagrs. tables. (Technical rept. no. 20) (AFOSR-2745) (AF 49(638)367) Unclassified

The purpose of this study is to investigate selection learning. In selection learning S is required to choose the items that he will learn from the total number of items with which he is presented. This choice is made on the basis of the presentation of a selection cue. The selection cue was varied in an attempt to investigate the 2 processes assumed to be active in selection learning: inhibition and facilitation. Selection learners were also compared with ordinary rote learners. Results for acquisition indicated that all conditions of learning were equal. After a 1 hr interpolated interval no difference was found between selection and ordinary rote learners. The result was at variance with previous studies in selection learning. The forgetting of incidental items was found to be significant in determining retention of intentional items in selection learning. Possible explanations were given for the effect of the selection cue on selection learning. Both facilitation and inhibition were concluded to be a function of the degree to which cue-producing orienting responses were evoked during acquisition in selection learning. This, however, was only a tentative speculation. (Contractor's abstract)

2001

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. IX. SOME EFFECTS OF CONDITIONED FEAR ON STIMULUS GENERALIZATION, by A. R. Platz. May 1962, 104p. (Technical rept. no. 19) (AFOSR-2834) (AF 49(638)367) AD 288189 Unclassified

The present study represents one of a series of tests of the hypothesis that drives affect the location of stimuli on intensity investigations. This modification of Hull-Spence behavior theory provides one approach for attacking the problems of perception within a theory which has already proved useful in studying learning phenomena and suggestive in the areas of personality research and social phenomena. It was argued that the drive-stimulus interaction hypothesis is consistent with the experimental data on perceptual effects of motivation, and provides a powerful tool both for integrating these data and for suggesting new tests of this interaction. Implications of the hypothesis were spelled out for accentuation effects, drive effects on recognition threshold, sensory interaction and discrimination learning.

2002

Michigan U. [Speech Research Lab.] Ann Arbor.

AN AUTOMATIC SPEECH FORMANT TRACKING FILTER, by G. A. Hellwarth. May 1962, 123p. incl. illus. diagrs. refs. (Rept. no. 10) (AFOSR-2591) (AF 49(638)492) AD 282147 Unclassified

The various methods which have been employed for speech analysis are discussed with emphasis on transformations of the signal from the time domain to the time-frequency domain. Procedures are given for simplifying the results of the transformation in order to reduce the channel capacity required to describe the speech signal. Formant coding systems appear to yield great promise if accurate location of the speech formant frequencies can be obtained from the time-frequency transformation. As a solution to formant frequency measurement in real time, a continuously tuned, automatic tracking filter system is proposed which locates these spectral maxima of speech signals through an application of automatic frequency control techniques. The experimental circuitry is described, stability and performance characteristics are given for this feedback control system and several figures are shown to demonstrate the ability of the system to track speech formants. The problem of constructing a complete speech analysis system utilizing tracking filters is discussed. (Contractor's abstract, in part)

2003

Michigan U. [Speech Research Lab.] Ann Arbor.

ATTENDANCE AT EUROPEAN CONFERENCES ON ACOUSTICS AND SPEECH, Aug. 16-Sept. 14, 1962, by G. E. Peterson and J. E. Shoup. Oct. 10, 1962, 16p. (AFOSR-3882) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)492 and National Institutes of Health) AD 289314 Unclassified

This report is concerned primarily with attendance at 3 conferences in Europe held during Aug. and Sept. 1962: Fourth International Congress on Acoustics, Copenhagen (Denmark); Speech Communication Seminar, Stockholm (Sweden); and Twelfth Congress of the International Association of Logopedics and Phoniatrics, Padova (Italy). The chief interests were in speech, and most of the time was devoted to attending sessions on this subject.

2004

Michigan U. [Willow Run Labs.] Ann Arbor.

PARAMAGNETIC RESONANCE SPECTRUM OF VANADYL AMMONIUM SULFATE (Abstract), by R. Borcherts, G. Wepfer, and C. Kikuchi. [1962] [1]p. [AF 49(638)987] Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc. Series II, v. 7: 118. Feb. 23, 1962.

This investigation of the oxidation states of vanadium is a continuation of the work done on vanadium in sapphire (item no. 1239, Vol. III). A sample of $(NH_4)_2Zn(SO_4)_2 \cdot 6H_2O$ containing approximately 0.1% VO^{++} has been grown by evaporation yielding single crystals of this Tutton Salt. The hyperfine separation at a frequency of 9.2865 ± 5 kmc was found to be 81.0 ± 0.5 gauss parallel to the tetragonal axis ($g_{||}$ = 1.993 ± 4) and 160.2 ± 0.5 gauss perpendicular to the tetragonal axis ($g_{\perp}$ = 1.971 ± 4). Powdered samples have 2 sets of 8 peaks. The more intense set has a separation of 78 ± 1 1 gauss (g = 1.99) whereas the weaker set has a separation of 200 ± 1 gauss (g = 1.95). This powdered spectrum is similar to that of vanadium pentoxide in glass (unpublished) and Oxovanadium (IV). Upon x-irradiation of a single crystal divalent vanadium is produced.

2005

Midwest Research Inst., Kansas City, Mo.

LARGE DEFLECTION PANEL FLUTTER, by E. F. E. Zeijdel. [1962] [128]p. incl. diagrs. tables, refs. (AFOSR-1952) (AF 49(638)389) AD 270855 Unclassified

A supersonic flutter analysis of an infinite span plate, which is separated into an array of rectangular panels, is presented. The region between Mach 1 and the $\sqrt{2}$ is of specific interest and linearized 3-dimensional aerodynamic theory is applied. The elastic behavior of the configuration is described by nonlinear plate theory to obtain a criterion of failure at large deflection. Specializing to those cases with relatively large aspect ratio and supports which are unrestrained in the chordwise direction, an estimation of maximum stress due to large deflection is given. Static membrane forces in the spanwise direction are also considered. Numerical results are derived and the effects of number of degrees of freedom, aspect ratio, structural damping, number of panels in the chordwise direction, static membrane forces in the spanwise direction, and large deflection examined. (Contractor's abstract)

2006

Midwest Research Inst., Kansas City, Mo.

EFFECTS OF EXTERNAL FORCE EXCITATION ON PANEL FLUTTER, by E. F. E. Zeydel and D. R. Kobett. Dec. 1962, 54p. incl. diagrs. tables. (AFOSR-4665) (AF 49(638)389) AD 451691L Unclassified

A supersonic flutter analysis of an infinite span plate, which is separated into an array of rectangular panels, is presented. The region between Mach 1 and $\sqrt{2}$ is of specific interest and linearized 3-dimensional aerodynamic theory is applied. The elastic behavior of the configuration is described by small deflection theory. The partially clamped edge condition is obtained by introducing a torsional restraint proportional to the first derivative of the transverse deflection along the normal to the edge. Numerical results are given in terms of characteristic panel flutter parameters. The effects of Mach number, aspect ratio, number of panels in the chordwise direction, panel material, and altitute are examined. (Contractor's abstract)

2007

Milan U. (Italy)

OXYGEN AND HYDROGEN PEROXIDE ELECTROCHEMICAL BEHAVIOUR ON COPPER ELECTRODES, by G. Bianchi, G. Caprioglio, and T. Mussini. Jan. 1962 [22]p. incl. diagrs. refs. (Technical note no. 7) (AFOSR-2051) (AF 61(052)260) AD 291689 Unclassified

Oxygen cathodic reduction on Cu has been investigated in acid, neutral and alkaline solutions, together with the parallel process of H_2O_2 cathodic reduction. Two reaction mechanisms have been outlined: the former involving Cu compounds and the latter involving the depolarization of atomic hydrogen formed at the Cu surface owing to cathodic polarization. This process may be compared with the similar one observed when Au is concerned. (Contractor's abstract)

2008

Milan U. (Italy).

OXYGEN AND HYDROGEN PEROXIDE ELECTROCHEMICAL BEHAVIOUR ON CHROMIUM, NICKEL, COBALT AND STAINLESS STEEL ELECTRODES, by G. Bianchi, F. Mazza, and T. Mussini. Feb. 1962 [39]p. incl. diagrs. refs. (Technical note no. 8) (AFOSR-2052) (AF 61(052)260) AD 278690 Unclassified

As far as a Ni electrode is concerned, in neutral solution the O_2 cathodic reduction is an indirect reduction through the redox couple Ni_3O_4/NiO, due to the fact that NiO can adsorb large quantities of O_2 with formation of Ni_3O_4. Again in the case of H_2O_2 solutions the cathodic process is ascribed to an indirect H_2O_2 reduction: H_2O_2 form Ni_3O_4 on Ni surface and thus H_2O_2 reduction occurs through the redox couple Ni_3O_4/NiO. During the H_2O_2 anodic oxidation Ni electrode is deemed to be coated with a Ni_3O_4 layer acting as electrode on which H_2O_2 oxidates at about +500 mv as it was previously observed for magnetite and other metals. The situation is analogous for alkaline solutions. Similar considerations are valid for a Co electrode. In the case of Cr it has been confirmed that no condition allows H_2O_2 formation by O_2 cathodic reduction (this result is verified again in the case of Ni and Co electrodes). It is very particular that O_2 and H_2O_2 cathodic reductions occur for Cr at a potential of about -200 mv independent of the fact that alkaline, neutral or acid solutions are concerned. As far as a stainless steel electrode is concerned, the conclusion can be drawn that stainless steel in neutral media behaves like Fe, from the point of view of O_2 and H_2O_2 reduction; like Cr in alkaline media. (Contractor's abstract)

2009

Milan U. (Italy).

BASIC RESEARCHES IN METAL CORROSION — ELECTROCHEMICAL BEHAVIOUR OF OXYGEN AND HYDROGEN PEROXIDE, by G. Bianchi. Final technical rept. Mar. 30, 1962, 8p. incl. refs. (AFOSR-2053) (AF 61-(052)260) AD 283522 Unclassified

The scientific, practical and indirect results of research carried out to explain the mechanism of corrosion processes involving oxygen cathodic reduction are summarized. The experimental results concerning oxygen and hydrogen peroxide cathodic reduction are of interest also in the field of fuel cells. (Contractor's abstract)

2010

Milan U. (Italy).

CATALYTIC DECOMPOSITION OF ACID HYDROGEN PEROXIDE SOLUTIONS ON PLATINUM, IRIDIUM, PALLADIUM AND GOLD SURFACES, by G. Bianchi, F. Mazza and T. Mussini. [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-4236) (AF 61(052)260) AD 449072 Unclassified

Also published in Electrochim. Acta, v. 7: 457-473, July-Aug. 1962.

The catalytic decomposition of acid H_2O_2 solutions in presence of Pt, Ir, Pd, and Au has been studied. In H_2SO_4 solution, Pt, Ir, and Pd are catalytically active; Au is not active. In HCl solution, none of the above metals is active. The H_2O_2 decomposition is a first order reaction. The surface of the electrode becomes practically covered by a monomolecular layer of oxide during the catalytic H_2O_2 decomposition in acid solution, as shown by anodic and cathodic polarization curves, anodic decay curves and anodic and cathodic charging curves. The metal loses its catalytic activity when it cannot be covered by an adsorbed oxide layer, as when it forms complexes with the solution: for instance, Pt and Ir in HCl solutions or Au in H_2O_2 solutions. The

different rate of oxide formation by H_2O_2 and of the reaction between oxide and H_2O_2 to develop O_2 explains the differences of catalytic activity observed between Pt, Ir, and Pd. (Contractor's abstract)

2011

Milan U. (Italy).

NEW HYDRIDES OF TRANSITION METALS, by L. Malatesta. Annual technical rept. Nov. 1961-Oct. 1962. Nov. 10, 1962, 9p. incl. refs. (AFOSR-4746) (AF FO-AR-62-34) AD 407611 Unclassified

Work carried out on iridium complex hydrides, which was published in Gazz. Chim. Ital. with the title Trihydrido tristriphenylphosphineiridium compounds, is described. Work carried out on rhenium complex hydrides is also described. Two very interesting new compounds of this class are reported. Research on complex hydrides of gold is reported. This research led to the discovery of some very unusual derivates of zerovalent gold. Research on complex hydrides of copper was undertaken, and a few preliminary results are discussed. (Contractor's abstract)

2012

Milan U. (Italy).

TRIPHENYLPHOSPHINIC IRIDIUM HYDRIDES. I, by M. Angoletta. [1962] [7]p. (AFOSR-J1510) [AF EOAR-63-34] Unclassified

Also published in Gazz. Chim. Ital., v. 92: 811-817, 1962. (Title varies)

The following sequence was investigated: $IrBr_3$ + $3PPh_3$ + (H) (from $NaBH_4$) - $IrH_3(PPh_3)_3$ (I) + $HClO_4$ - $IrH_2(PPh_3)_3ClO_4$. $Ir(OH)_3$ was precipitated from 10 g. $K_2Ir\,Br_6$ in hot H_2O with 2.82 g Na_2CO_3 while adjusting the pH to 7-7.5. Assignment of the cis and trans structures is based on dipole moments and confirmed by the infrared spectrum, showing 2 separated bands for σ (1730 and 2100 cm^{-1}) and only one for ϱ (2080), the latter indicating 2 H in trans positions.

2013

Milan U. [Lab. of Physiology] (Italy).

INVESTIGATIONS OF THE EFFECT OF REPEATED HIGH G FORCES ON FROGS, by T. Gualtierotti, L. Gallitelli, and R. Margaria. [1959] [4]p. (AFOSR-3383) (AF 61(0520)23) AD 629110 Unclassified

Also published in Atti. Cong. Internaz. Med. Aeronaut. e Spaziale, v. 2: 527-529, Oct. 1959.

The recovery of the sense of balance after high G centrifugation in frogs does not seem to be achieved through a mechanism involving sight or muscle sense or touch. The possibility exists that the otolothic system is rebuilt; in this case however the otoliths may be so small as not to be affected by 2000 G centrifugation. Some still unknown mechanism for a gravitational orientation may exist in frogs.

2014

Milan U. Lab. of Physiology (Italy).

FUNCTIONAL FUNDAMENTAL CHARACTERISTICS OF THE NERVOUS SYSTEM IN ATHLETES AND THE EFFECTS OF PERFORMANCE, by R. Margaria and T. Gualtierotti. [1959] [10]p. incl. diagrs. (AFOSR-3453) (AF 61(052)23) AD 629111 Unclassified

A statistical investigation was made in order to define the changes induced in the central nervous system by physical fatigue and to individuate the possible responsible mechanisms. Subjects performed exhaustive physical exercises after which total reflex time, spinal delay, endplate delay, and motor and sensory conduction speed were measured and compared to normal variability. The most consistent and significant effect of physical fatigue on the spinal cord was the shortening of the conduction time across the spinal centers. The physiological aspects and experimental error are discussed as possible causes of the increased variability observed in some of the data.

2015

Minnesota U., Minneapolis.

MARKOV PROCESSES ON AN ENTRANCE BOUNDARY, by F. [B.] Knight. [1961] [15]p. incl. refs. [AF 18-(603)30] Unclassified

Published in Illinois Jour. Math., v. 7: 322-336, June 1963.

It was proved that a simple Markov process can be reviewed as the prosection onto the original phase space of a strict Markov process on a ramified phase space. Here a new ramification is studied. Given a sample path $t \to x(t)$ of the original motion, the phase of the ramified path at time $t \geq 0$ can be described (a little informally) as the point on the Martin entrance boundary for $x(s)$; $s > t$ to which $x(s)$ tends as $s \downarrow t$; the ramified path is continuous from the right and strict Markov, and the ramified phases can be identified with families of limits of transition probabilities. This theory coincides with the previously proven theory if and only if

$\int_0^\infty e^{-t} P_a[x(t) \in B]dt$ tends to 0 uniformly in a as $B \downarrow 0$.

(Math. Rev. abstract)

2016

Minnesota U., Minneapolis.

RANDOM WALKS AND A SOJOURN DENSITY PROCESS OF BROWNIAN MOTION, by F. B. Knight. [1962] [31]p. incl. refs. [AF 18(603)30] Unclassified

Published in Trans. Amer. Math. Soc., v. 109: 56-86, Oct. 1963.

Consider a standard 1-dimensional Brownian motion with sample paths $t \to x(t)$ and define the local time

$$t(t, a) = \lim_{b \downarrow a} \frac{\text{measure } (s: a \le x(s) < b,\ s \le t)}{2(b - a)}.$$

H. Trotter proved that t is continuous in the pair $(t, a) \in [0 + \infty] \times R^1$ and found a Hölder condition for it. The author's main result is that if $T = t^{-1}(t)$ is the inverse function of $t(t, 0)$, then $y(a) = T(T, a)$, considered as a stochastic process with parameter $a \ge 0$, is a diffusion with starting-point t, generator $4y\, d^2/dy^2$, and an absorbing barrier at $y = 0$. The proof is based on the author's approximation to the Brownian motion by random walks. More recently, D. B. Ray has found that, conditional on $x(T) = b$, $v(a) = t(T, a)$ is a still diffusion for T belonging to a wide class of stopping times including Knight's inverse local times $t^{-1}(t)$, passage times, and constant times. Using either Knight's or Ray's result, the exact Hölder condition for $t(t, a)$ as a function of a can be found.

2017

Minnesota U., Minneapolis.

FERROMAGNETIC RESONANCE OF SINGLE-DOMAIN PARTICLES, by E. P. Valstyn, J. P. Hanton, and A. H. Morrish. [1962] [10]p. incl. illus. diagrs. tables, refs. (AFOSR-2938) (AF 49(638)803) AD 296209 Unclassified

Also published in Phys. Rev., v. 128: 2078-2087, Dec. 1, 1962.

The ferromagnetic-resonance spectra of powders containing single-domain particles have been studied experimentally and theoretically. The theory is based on the Stoner-Wohlfarth model. The line shapes were calculated with the aid of a high-speed digital computer. Measurements were made on γ-Fe_2O_3 powders, both with and without an applied steady magnetic field. For zero applied steady field, the theoretical line shapes agree well with the experimental ones provided the particle shape distribution, the crystalline anisotropy, and the particle interactions are taken into account. With an applied field, the theoretical curves with only the shape distribution considered do not agree with the theoretical ones. It is found that the anisotropy constant K_1 and the relaxation time τ of γ-Fe_2O_3 are approximately 2.5×10^5 ergs/cm^3 and 2.0×10^{-10} sec, respectively. (Contractor's abstract)

2018

Minnesota U., Minneapolis.

EFFECT OF SURFACE ROUGHNESS ON MAGNETIC PROPERTIES OF FILMS, by R. J. Prosen, B. E. Gran and others. [1962] [2]p. incl. diagr. table. (AFOSR-J559) (AF 49(638)803) AD 408579 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1147-1148, Apr. 1963.

The conditions of the surface have been found to have a profound influence on the magnetic properties of thin Permalloy films. Quantitative measurements of the surface area were determined by adsorption of a C^{14}-labeled surfactant. Static hysteresis curves, torque curves, and ferromagnetic resonance spectra have been measured and related to surface roughness. Biaxial anisotropy has been observed for films deposited on unidirectionally scratched substrates. The linewidth of the uniform precessional mode with the magnetic field applied parallel to the plane of the film is increased with increasing surface roughness. (Contractor's abstract)

2019

Minnesota U., Minneapolis.

FERROMAGNETIC-RESONANCE LINE SHAPE OF SINGLE-DOMAIN PARTICLES (Abstract), by A. H. Morrish, E. P. Valstyn, and J. P. Hanton. [1962] [1]p. [AF 49(638)803] Unclassified

Presented at meeting of the Amer. Phys. Soc., Seattle, Wash., Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 448, Aug. 27, 1962.

The ferromagnetic-resonance (FMR) spectra of powders containing single-domain particles have been studied experimentally and theoretically. Measurements from dc to 9 kmc in zero-applied steady magnetic field were made on powders of γ-Fe_2O_3. This experiment has the advantage that magnetization reversals do not occur. In contrast, reversals, which may be incoherent, do not take place in coercive force, remanence, and other measurements. The powders differed in their particle shape and size distribution. The FMR line shape was found to be rather broad and flat, and to depend on the particle-shape distribution. A calculation of the line shape was made with the aid of a fast digital computer. Approximate agreement between theory and experiment is obtained by taking into account only the particle-shape distribution as determined by an electron microscope. However, in order to achieve good agreement, it was necessary to consider the crystalline anisotropy and the particle interactions. The value of the crystalline anisotropy constant required to fit the data is in good accord with that deduced from FMR experiments at 9 and 24 kmc in an applied steady magnetic field.

2020

Minnesota U., Minneapolis.

THE ILSTOW AND FEYNMAN INTEGRALS, by R. H. Cameron. [1962] [75]p. (AFOSR-J443) [AF AFOSR-62-252] Unclassified

Also published in Jour. Anal. Math. (Jerusalem), v. 10: 287-362, 1962/1963.

Gel'fand and Jaglom pointed out that if $f = f(x)$ is a nice functional of the standard Brownian path $x(t)$: $t \leq 1$ starting at $x(0) = 0$, then the Wiener integral $\int f[\sigma x(t): t \leq 1]\, dx = \int f[x(\sigma^2 t): t \leq 1]dx$, defined at first for $\sigma > 0$, has an analytic continuation over the region $R(\sigma^2) > 0$, permitting the definition of the Feynman integral of f as $\lim_{\sigma^2 \to 1, R(\sigma^2) > 0} \int f[\sigma x]\, dx$ in some cases. Cameron took up this idea approximating the integrals by finite-dimensional integrals and connecting them by analytic continuation as above. This investigation is now continued by using the fact that $\int f[\sigma x]\, dx$ can be expressed as a Laplace transform with parameter σ^{-2}, and conditions are found for the existence of the Feynman integral of a tame function f; for example, it is found that if $f = g[\int_0^1 h(t)dx(t)]$ with $\int_0^1 h^2\, dt < \infty$ and $\int |dg| < \infty$, then f is Feynman-integrable and its integral is $(2\pi i)^{-1} \times \int g(u) \exp(iu^2/2)du$. An application to the Schrödinger equation is made. (Math. Rev. abstract, modified)

2021

Minnesota U. [Dept. of Aeronautical Engineering] Minneapolis.

COMPRESSION TESTS OF SANDWICH PANELS WITH FACINGS AT DIFFERENT TEMPERATURES, by C. C. Chang and M. J. Timmons, Jr. [1962] [8]p. incl. illus. diagrs. tables. (AF 18(603)112) Unclassified

Presented at Spring meeting of the Society for Experimental Stress Analysis, Dallas, Tex., May 16-18, 1962.

Published in Exper. Mech., v. 2: 249-256, Aug. 1962.

A series of tests were conducted on simply supported sandwich panels with 2 edges loaded in compression and with a thermal gradient between the 2 facings. The results of these tests, on aluminum and stainless-steel honeycomb-sandwich panels, are compared with a new theory with good correlation in the elastic range. Empirically, it was found that the experimental deflection pattern correlates well with the assumed orthogonal sine-wave deflection pattern. (Contractor's abstract)

2022

Minnesota U. [Dept. of Electrical Engineering] Minneapolis.

LIFETIME OF HELIUM METASTABLE ATOMS; MOBILITY AND AFTERGLOW STUDIES IN HELIUM, NEON, AND ARGON (Abstract), by H. J. Oskam, V. R. Mittelstadt and others. [1962] [1]p. [AF AFOSR-62-103] Unclassified

Presented at meeting of the Amer. Phys. Soc., Boulder, Colo., Oct. 10-12, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 636, Dec. 27, 1962.

Studies of helium metastable atoms by the absorption technique gave the following results: (a) The diffusion coefficients of the singlet and triplet metastable atoms are the same; the value agrees with that measured by Phelps as did the destruction frequency of the triplet state due to 3-body collisions with helium atoms, (b) When correcting the absorption signal for the emission signal at the same wavelength, no evidence was found for conversion of the singled state into the triplet state by superelastic collisions with electrons as postulated by Phelps, and (c) Preliminary measurements indicated a destruction frequency of the singlet state by collision-induced radiative transitions smaller than found by Phelps. The microwave-cavity method and the ion-transit-time method gave, with respect to ion mobilities, the following consistent data: (a) agreement for He^+, Ne^+, Ne_2^+, and Ar^+ ions with all previous measurements; (b) $\mu_0(He_2^+) = 16.2$ cm/sec per v/cm in contrast with all previous measurements; $\mu_0(Ar_2^+) = 1.85$ cm/sec per v/cm as measured for one of the 3 ions observed by Beaty in argon. The pressure dependence of the cataphoresis effect in helium is a consequence of the production of neon ions by collisions of He_2^+ with neon atoms.

2023

Minnesota U. [Dept. of Mathematics] Minneapolis.

AN ERGODIC THEOREM FOR MARKOV CHAINS, by S. Orey. [1962] [3]p. (AFOSR-2375) (AF 49(638)617) Unclassified

Also published in Zeitschr. Wahrscheinlichkeitstheorie, v. 1: 174-176, 1962.

The following new ergodic theorem is proved: if p be recurrent, irreducible, and aperiodic, and x and y are 2 probability measures, then $\|(x - y)p^n\| \to 0$ as $n \to \infty$. The usual convergence result for Markov chains is proved as a corollary.

2024

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON THE CONFORMAL TYPES OF ALGEBRAIC SURFACES OF EUCLIDEAN SPACE, by A. M. Garsia. [1962] [12]p. (AFOSR-3243) [AF 49(638)857] Unclassified

Also published in Comment. Math. Helv., v. 37: 49-60, 1962.

The striking result is established that every compact Riemann surface is conformally equivalent to an algebraic surface $F(x, y, z) = 0$ of the Euclidean space (F a real polynomial in its arguments). For the proof, a theorem is given on uniform algebraic approximation of C^k manifolds.

2025

Minnesota U. Dept. of Mathematics, Minneapolis.

QUASI-CONFORMAL FUNCTIONS TENDING TO CONFORMALITY AT THE BOUNDARY, by D. A. Storvick. [1960] [11]p. (AFOSR-2794) (AF 49(638)863) AD 621219 Unclassified

The purpose of this note is to show that the boundary correspondence induced by a quasi-conformal mapping is absolutely continuous and an analogue of Fatou's theorem is valid for quasi-conformal functions if one requires that the dilatation quotient in addition to being bounded tends to one sufficiently swiftly as the boundary is approached.

2026

Minnesota U. [Dept. of Mathematics] Minneapolis.

HOLOMORPHIC FIBER BUNDLES OVER RIEMANN SURFACES, by H. Röhrl. [1962] [36]p. incl. refs. [AF 49(638)885] Unclassified

Presented at meeting of the Amer. Math. Soc., Milwaukee, Wis., Nov. 18, 1961.

Published in Bull. Amer. Math. Soc., v. 68: 125-160, May 1962.

This paper is a comprehensive and very useful survey of some recent developments in the study of holomorphic vector bundles over Riemann surfaces; many results are discussed, without proofs but with explicit references to the literature on this subject. The problem of classifying such bundles over compact Riemann surfaces is quite difficult, and satisfactory results are known only in the cases of surfaces of genus one or zero at present. This problem is discussed in detail. A similar problem arises in the classification of analytic families of vector bundles, a problem related quite closely to the modulus problem for Riemann surfaces. Various applications of properties of vector bundles are also discussed; included are Weierstrass and Mittag-Leffler theorems on Riemann surfaces, functional equations and factors of automorphy, and some questions on analytic systems of differential equations (the Riemann-Hilbert problem).

2027

Minnesota U. [Dept. of Mathematics] Minneapolis.

NON-DIFFERENTIABILITY OF ABSOLUTE PROBABILITIES OF MARKOV CHAINS, by S. Orey. [1962] [3]p. (AFOSR-3236) [AF AFOSR-62-171] AD 407898 Unclassified

Also published in Quart. Jour. Math. (Oxford), v. 13: 252-254, Dec. 1962.

Two examples are given showing that the absolute probabilities $p_j(t)$ of a continuous-time stationary Markov chain with a denumberable number of states are less well behaved than the transition probabilities $p_{ij}(t)$ (with row sums equal to 1) and $p_{ij}(t) \downarrow \delta_{ij}$ for $t \downarrow 0$. In the first example $p_1'(1) = -\infty$, in the second example $p_1(t)$ has for a given $t_0 \geq 0$ no derivative from the right in t_0. (Math. Rev. abstract)

2028

Minnesota U. Heat Transfer Lab., Minneapolis.

THERMAL DIFFUSION EFFECTS ON ENERGY TRANSFER IN A TURBULENT BOUNDARY LAYER WITH HELIUM INJECTION, by O. E. Tewfik, E. R. G. Eckert, and C. J. Shirtliffe. [1962] [20]p. incl. diagrs. table, refs. (AFOSR-2307) (AF 49(638)558) Unclassified

Also published in Proc. 1962 Heat Transfer and Fluid Mechanics Inst., Washington U., Seattle (June 13-15, 1962), ed. by F. E. Ehlers, J. J. Kauzlarich and others, Stanford U. Press, 1962, p. 42-61.

A circular cylinder with 2-in. diam and with a porous wall fabricated out of woven wire material was aligned with its axis parallel to an air stream with approximately 100 ft/sec velocity. Helium gas was injected into the turbulent boundary layer through the cylinder walls at a uniform rate in the range 1.55×10^{-4} to 1.08×10^{-3} of the free stream mass velocity. The local energy transfer along the cylinder was measured at various values of the wall temperature level where energy flows from the cylinder to the boundary layer and vice versa. Results showed that the wall temperature for zero energy transfer was larger than the free stream temperature by up to about 40°F, although viscous dissipation effects are negligible. This temperature excess increases with increasing injection rate and is independent of Reynolds number. An analysis in which the laminar sublayer is treated as Couette flow with helium injection and which includes thermal diffusion in this layer is formulated. Results show appreciable thermal diffusion effects on adiabatic wall temperature, increasing it over its value for zero injection by amounts of the same order of magnitude as found by measurements. Thermal diffusion, however, has negligible effects on the heat transfer coefficient. Its effects on the concentration and temperature distribution are discussed and shown to produce appreciable modifications in the latter. (Contractor's abstract)

2029

Minnesota U. Heat Transfer Lab., Minneapolis.

THERMAL DIFFUSION IN LAMINAR BOUNDARY LAYERS OF BINARY MIXTURES OVER A SOLID, ADIABATIC FLAT PLATE, by A. A. Hayday, E. R. G. Eckert, and W. J. Minkowycz. May 1962, 42p. incl. diagrs. refs. (Technical rept. no. 48) (AFOSR-3497) (AF 49(638)556) AD 283369 Unclassified

An analytical study of the influence of thermal diffusion on steady laminar boundary-layer flow of binary gaseous mixtures past a semi-infinite flat plate is reported. The Soret-Dufour effects are evaluated for He-air and H-air mixtures taking into account the influence of free-

stream Mach number, free-stream concentration, and temperature. The results obtained belong to the well known class of similar solutions. In all cases, the plate is assumed to be in thermodynamic equilibrium and without mass absorption or release into the fluid. The results may therefore be interpreted as generalized solutions to the recovery problem. The effect of diffusion on the thermal recovery factor is found to be within 0.5 and 1% for He-air and H-air mixtures near sonic velocity. It increases to 13% for H-air mixtures at a Mach number 10.

2030 -

Minnesota U. Heat Transfer Lab., Minneapolis.

TRANSPIRATION COOLING IN A MAGNETOHYDRODYNAMIC STAGNATION-POINT FLOW, by E. M. Sparrow, E. R. G. Eckert, and W. J. Minkowycz. [1962] [23]p. incl. diagrs. tables, refs. (AFOSR-3985) (AF 49(638)-558) Unclassified

Also published in Appl. Scient. Research, v. 11A: 125-147, 1962.

An analysis has been made to determine the reduction in stagnation point heat transfer when blowing and a magnetic field act simultaneously. It is found that in the presence of blowing, the magnetic field may be considerably more effective in reducing heat transfer than in the no-blowing case. The results show that the heat transfer reduction due to the simultaneous action of blowing and magnetic field is greater than that attained by multiplying together the separate reductions due to blowing alone and magnetic field alone. This favorable interaction diminishes as the Prandtl number diminishes and thus may be of lesser importance for highly ionized gases for which the Prandtl number is low. The analysis is carried through for both 2- and 3-dimensional stagnation points, and results are reported for Prandtl numbers of 0.01, 0.1, 0.7, 1, and 10. (Contractor's abstract)

2031

Minnesota U. Heat Transfer Lab., Minneapolis.

SOME CHARACTERISTICS OF THE TURBULENT BOUNDARY LAYER WITH AIR INJECTION, by O. E. Tewfik. [1962] [7]p. incl. diagrs. refs. (AFOSR-J1033) (AF 49(638)558) AD 417821 Unclassified

Also published in AIAA Jour., v. 1: 1306-1312, June 1963.

Measurements of turbulent velocity profiles on a 2-in.-o.d. circular cylinder, aligned with its axis parallel to an approximately 110-fps air stream and with air injection into the boundary layer, are described. The injection rate per unit area of cylinder surface was uniform and equal to 0.00107, 0.00202, 0.00312 of the free-stream mass velocity. By means of appropriate mass and momentum balances, the local and average skin friction and the distributions of the radial velocity component and shear through the boundary layer were determined

2032

Minnesota U. Heat Transfer Lab., Minneapolis.

DIFFUSION-THERMO EFFECTS ON HEAT TRANSFER FROM A CYLINDER IN CROSS FLOW, by O. E. Tewfik, E. R. G. Eckert, and L. S. Jurewicz. [1962] [7]p. incl. diagrs. table, refs. (AFOSR-64-0143) (AF 49-(638)558) AD 431009 Unclassified

Also published in AIAA Jour., v. 1: 1537-1543, July 1963.

Measurements are described of the distributions of the heat transfer coefficient and adiabatic wall temperature around a 3-in.-o.d. circular cylinder with a stainless steel woven-wire porous wall, and with its axis normal to a low-speed air stream. Helium was injected through the cylinder wall into the boundary layer at an approximately uniform rate per unit area of outside cylinder surface in the range of 5.45 to 25.8 lbm-hr-ft^2. The range of freestream velocity was 62.9 to 99.0 fps and of free-stream Reynolds number based on cylinder diameter 1.01×10^5 to 1.59×10^5. It was determined that, when the heat exchange between cylinder and air stream was zero, the wall temperature exceeded the freestream temperature by up to 86 F, depending upon location on cylinder circumference, helium injection rate, free-stream velocity, and properties. This phenomenon is due to the diffusion-thermo effect. The measured heat transfer coefficients at the forward stagnation point agreed fairly well with analyses that did not include the diffusion-thermo effect provided that the heat transfer coefficient was defined with the difference between the wall temperature and the adiabatic wall temperature. (Contractor's abstract)

2033

Minnesota U. Heat Transfer Lab., Minneapolis.

MEASUREMENTS OF THERMAL CONDUCTIVITY OF POROUS ANISOTROPIC MATERIALS, by O. E. Tewfik. [1962] [3]p. incl. diagrs. (AF 49(638)558) Unclassified

Published in AIAA Jour., v. 1: 919-921, Apr. 1963.

Measurements of the thermal conductivity along several directions and at various average temperature levels of a stainless steel, woven-wire, porous, anisotropic material are described. The material was 0.040-in. thick and was made out of 2 screens of mesh counts 50 x 250 and 16 x 64 wires/in. by calendering and sintering. Estimated error in the results is ± 2%. When compared with the predictions of the thermal ellipse, the results agreed within 1%.

2034

Minnesota U. Heat Transfer Lab., Minneapolis.

ON THE COUPLING BETWEEN HEAT AND MASS TRANSFER, by O. E. Tewfik, and C. J. Shirtliffe. [1962] [2]p. incl. diagrs. [AF 49(638)558] Unclassified

Published in Jour. Aerospace Sci., v. 29: 1009-1010, Aug. 1962.

Results show that it is possible to separate the heat flux at the model wall into one part depending on the temperature gradient and a second part caused by the coupling. It is also shown that the latter exceeds the former, and hence the coupling may not be neglected a priori without careful consideration.

2035

Minnesota U. Rosemount Aeronautical Labs., Minneapolis.

WIND TUNNEL INVESTIGATION OF A SPIKE-BLUFF BODY COMBINATION FOR A MONORAIL ROCKET SLED M = 2.0 TO M = 5.0, by R. Hermann, F. Moynihan, and D. Olson. Sept. 1962 [102]p. incl. illus. diagrs. tables. (Rept. no. RAL-RR-186) (AFOSR DRA-62-18) (AF 29(600)2839) AD 290609 Unclassified

Results of wind tunnel measurements of lift, drag, and pitching moment on a circular cross-section monorail sled using a flow separation spike including the influence of ground interference are presented and discussed. Variables investigated were the spike length, spike diameter and location on a series of sled nose shapes. Mach number range was from 2 to 5. The sled configuration having the largest drag (spike retracted) and the lowest drag (spike extended) was that with a flat face sled nose and with the spike mounted on the sled axis. The spike length for minimum drag, in general, became longer at higher speeds. Sled lift was essentially unaffected by variation of the spike length. Diameter of the spike had effect on the overall lift or drag. Unsteady flow phenomena (buzzing) were observed for some sled configurations at spike lengths on the order of 1 to 1.5 body diameters, but not at spike lengths for minimum drag. When buzzing occurred, it could be reduced or eliminated by rounding the sled nose shoulder. Mounting the spike below the sled axis diminished the drag reduction characteristics of the spike, increased the incidence of buzzing, but decreased the sled lift.

2036

Minnesota U. Rosemount Aeronautical Labs., Minneapolis.

WIND TUNNEL INVESTIGATION OF AERODYNAMICS OF SLIPPER BEAMS AS MOUNTED ON A TYPICAL SUPERSONIC ROCKET SLED, by F. Moynihan and R. Hermann. Oct. 1962, 33p. incl. illus. diagrs. tables. (Rept. no. RAL-RR-190) (AFOSR DRA-62-19) (AF 29(609)2839) AD 294602 Unclassified

Results of wind tunnel measurements of lift and drag of slipper beams when mounted on a basic sled configuration are presented and discussed. The pressure distributions on the top and bottom of the sled body are also presented. Variables investigated were location of front slipper beam and front and rear slipper beam fairing shape. Mach number range was from 1.5 to 4. Simulated track cross section was that of the Air Force Missile Development Center at the Holloman Air Force Base, New Mexico. The results show that the slipper beam lift characteristics can predominate and by proper shape and location of the slipper beams, the overall sled lift can be effectively controlled. For example, the overall lift can be made negative over the whole Mach number range by using obviously negative lift fairings and by locating the front beam forward of the nose-body shoulder, and by placing the front beam at the shoulder the overall lift is approximately zero over the same speed range. (Contractor's abstract)

2037

Minnesota U. Rosemount Aeronautical Labs., Minneapolis.

AERODYNAMIC AND HEAT TRANSFER STUDIES WITH EVAPORATIVE FILM COOLING AT HYPERSONIC MACH NUMBERS, by R. Hermann and W. L. Melnik. Sept. 1962, 87p. incl. illus. diagrs. refs. (Research rept. no. 189) (AF 49(638)190) AD 404197 Unclassified

A theoretical model of evaporative film cooling was developed for blunt bodies indicating the effect of mass transfer on heat transfer for Prandtl and Lewis numbers unity. The velocity of the liquid film at the gas-liquid interface is assumed to be so small that the gaseous phase is unaffected. This assumption was verified by a numerical example from the analysis. With this approximation, the effect of mass transfer (evaporation from the liquid film) on heat transfer from the gas-phase boundary layer was obtained from the literature on transpiration cooling. The velocity profile through the liquid film was found to be identical to that of a Couette flow with pressure gradient. The evaporative film cooling experiments were conducted on hemisphere-cylinder, blunted cone, and flat-faced cylinder models at Mach number 6.8 in a high temperature hypersonic blowdown wind tunnel at the Rosemount Aeronautical Laboratories. (Contractor's abstract)

2038

Minnesota U. [School of Chemistry] Minneapolis.

THE COMPLEXING OF SODIUM ION WITH SOME COMMON METABOLITES, by O. Jardetzky and J. E. Wertz. [1956] [4]p. incl. diagrs. (AFOSR-'909) (AF 18(603)17) AD 415404 Unclassified

Also published in Arch. Biochem. and Biophys., v. 65: 569-572, Dec. 1956.

For abstract see item no. MIN.08:002, Vol. I.

2039

Minnesota U. School of Chemistry, Minneapolis.

POLAROGRAPHY OF MOLYBDENUM(VI) IN AQUEOUS SULFURIC ACID SOLUTIONS, by I. M. Kolthoff and I. Hodara. [1962] [13]p. incl. diagrs. tables, refs. (AFOSR-2596) (AF 49(638)519) AD 295890 Unclassified

Also published in Jour. Electroanal. Chem., v. 5: 369-381, 1962.

Polarograms of molybdenum(VI) were determined in solutions of varying molybdenum and sulfuric acid concentrations. Under suitable conditions, 2 clearly defined waves A and B are observed, wave A corresponding to the reduction of molybdenum(VI) to (V) and wave B of molybdenum(V) to (III). In 5 M sulfuric acid, wave A may be split into 2 waves, A_1 and A_2, the heights of which are diffusion controlled. These waves are attributed to the presence of different species of molybdenum(VI). In dilute sulfuric acid (0.1 M or less), wave B is split into 2 waves, B_1 and B_2, which are diffusion controlled and are attributed to the reduction of different species of molybdenum(V). The polarographic diffusion coefficient of molybdenum(VI) multiplied by the square root of the viscosity of the solution increases from $0.5 \cdot 10^{-5}$ in 0.1 M sulfuric acid to $0.6 \cdot 10^{-5}$ $cm^2 sec^{-1}$ in 5 M sulfuric acid. (Contractor's abstract)

2040

Minnesota U. School of Chemistry, Minneapolis.

THE STABILITY CONSTANT OF THE $H_2SO_4 \cdot HSO_4^-$ ION AND ITS MOBILITY IN ACETONITRILE, by I. M. Kolthoff and M. K. Chantooni, Jr. [1962] [4]p. incl. tables. (AFOSR-3946) (AF 49(638)519) AD 405789 Unclassified

Also published in Jour. Phys. Chem., v. 66: 1675-1678, Sept. 1962.

From the electrical conductance at 25° of mixtures of tetraethylammonium bisulfate and sulfuric acid in acetonitrile (AN), a value of 65 for the mobility at infinite dilution of the conjugate ion, $H_2SO_4 \cdot HSO_4^-$, has been derived. From the solubility in AN of sodium bisulfate in the presence of various concentrations of sulfuric acid, the solubility product of sodium bisulfate and the stability constant of the conjugate ion have been calculated to be 3×10^{-7} and 1.0×10^3, respectively. Knowing the mobility of the conjugate ion, a value of 1.0×10^3 for the stability constant was calculated from conductance data in pure sulfuric acid solutions in AN. The value of 1.0×10^3 is in excellent agreement with the value 1.15×10^3 obtained from indicator equilibria in solutions of sulfuric acid.

2041

Minnesota U. [School of Chemistry] Minneapolis.

POLAROGRAPHY AND AMPEROMETRY IN NON-AQUEOUS SOLVENTS, by I. M. Kolthoff. Final rept. Nov. 1, 1958-Oct. 31, 1962. Nov. 1, 1962, 4p. (AFOSR-4352) (AF 49(638)519) Unclassified

Research carried out under this contract is summarized. Extensive studies were made of acid-base equilibria in methyl isobutylketone and in non-waterlike solvents, with special emphasis on acetonitrile. A preliminary study of acid-base dissociation in the solvent dimethyl sulfoxide was made. A polarographic investigation was made of the molybdenum catalyzed reduction at the dropping mercury electrode of chlorate, perchlorate, and nitrate in aqueous medium. On the basis of this work, a method was developed to determine traces of molybdenum by measuring the catalytic chlorate reduction current. A list of publications resulting from this research is cited.

2042

Minnesota U. School of Chemistry, Minneapolis.

CALCULATED AND EXPERIMENTAL CONDUCTOMETRIC TITRATION CURVES OF INTERMEDIATELY STRONG ACIDS AND BASES IN ACETONITRILE, by I. M. Kolthoff and M. K. Chantooni, Jr. [1962] [5]p. incl. diagrs. tables. refs. (AFOSR-3439) (AF 49(638)519) AD 408603 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 426-430, Feb. 20, 1963.

An equation has been derived for the calculation of conductometric titration curves of intermediately strong acids with aliphatic amines in acetonitrile as a solvent. The calculations require a knowledge of the dissociation constants $K_{BH^+AHA^-}$ of the conjugate salt, $K_{BH^+A^-}$ of the simple salt, of the conjugation constant K_{AHA^-}, and of ionic mobilities. Good agreement between calculated and observed conductances has been found in the titration of varying concentrations of sulfuric acid with n-butylamine and of 3,5-dinitrobenzoic acid with triethylamine. From the solubility of potassium 3,5-dinitrobenzoate in solutions of varying concentration of the parent acid, the conjugation constant K_{AHA^-} was found to be equal to 1.7×10^4 while the solubility product of the salt is 5.3×10^{-8} at 25°. A list of other determined constants is given. The maximum in the conductometric titration curves is found at 50% neutralization of the acid when K_{AHA^-} is very large and $K_{BH^+A^-}$ small.

2043

Minnesota U. [School of Chemistry] Minneapolis.

[INVESTIGATION OF HELIUM II FILMS, AND SOUND VELOCITY IN $HELIUM^3$ AND $HELIUM^4$ GAS], by J. H. Werntz. Interim final rept. July 1, 1958-June 30, 1962. July 31, 1962, 3p. (AFOSR-3279) (AF 49(638)515) Unclassified

A summary is given of the investigations being pursued on the following subjects: (1) propagation of second sound in the helium II film; (2) velocity of ordinary sound in helium vapor; (3) thermally induced helium film flow; and (4) the $helium^3$ refrigerator.

2044

Minnesota U. [School of Chemistry] Minneapolis.

ELECTRON SPIN RESONANCE STUDIES OF SOLID

DEFECTS, by J. E. Wertz. Final rept. Jan. 1, 1960-Dec. 31, 1961. Feb. 1962 [22]p. (AFOSR-2384) (AF 49-(638)683) Unclassified

The work reported here represents a 2-yr period (1960-61) in the study of properties of oxides begun in 1953. Most of the work deals with single crystals of magnesium oxide, but work was also done on powders of magnesium, calcium, strontium and barium oxides. Results on powdered MgO has made it encouraging to work on the other oxides. Additionally, results are reported on the isotropic (or nearly isotropic) defects in the sulfides and selenides of the alkaline earth metals (excluding those of beryllium). The defects include impurities in their usual valence states and in unusual ones as well, e.g., the monovalent ions of iron, cobalt, and nickel. In some cases, there is association of vacancies with other defects. Other defects included trapped electrons and trapped holes. Some of these centers were observed in neutron-irradiated samples, while others could be produced by 4.9 ev- or x-irradiation. Evidence was obtained for Jahn-Teller distortions with the ions Cu^{2+} and Ni^{1+} in MgO, the distortions being mobile above 4°K, but frozen-in at lower temperatures. The establishment of double-quantum electron spin resonance transitions for Ni^{2+} and Co^{1+} led to an estimate for the nuclear magnetic of Ni^{61}, which was heretofore unknown. (Contractor's abstract)

2045

Minnesota U. School of Chemistry, Minneapolis.

ELECTRON SPIN RESONANCE OF F CENTERS IN MAGNESIUM OXIDE: CONFIRMATION OF THE SPIN OF MAGNESIUM-25, by J. E. Wertz, P. Auzins and others. [1957] [3]p. incl. diagrs. refs. (AFOSR-3587) (AF 49(638)683) Unclassified

Also published in Phys. Rev., v. 107: 1535-1537, Sept. 15, 1957.

For abstract see item no. MIN. 12:013, Vol. II.

2046

Minnesota U. School of Chemistry, Minneapolis.

OXYMERCURATION OF CIS AND TRANS-2-BUTENE, by M. M. Kreevoy, L. L. Schaleger, and J. C. Ware. [1962] [6]p. incl. diagr. table, refs. (AFOSR-862) (AF 49(638)711) AD 613312 Unclassified

Also published in Trans. Faraday Soc., v. 58: 2433-2438, Dec. 1962.

Equilibrium constants have been measured for the reaction of cis and trans-2-butene with aqueous mercuric chloride to give threo- and erythro-3-chloromercuri-2-butanol. These have been combined with the known free energies of formation of the olefins to show that the free energy of isomerization of the oxymercurials is zero. The deoxymercurations of the threo- and erythro-3-iodomercuri-2-butanols by non-halogen acids proceed at nearly identical rates. They give the starting olefins without cross-contamination. These facts are interpreted in terms of the preferred orientation of the various groups. (Contractor's abstract)

2047

Minnesota U. School of Chemistry, Minneapolis.

THE SOLVOLYSIS OF 2-IODOMERCURIETHYL ESTERS, by M. M. Kreevoy and G. B. Bolem. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-1717) [AF 49(638)711] AD 438549 Unclassified

Also published in Jour. Org. Chem., v. 27: 4539-4542, Dec. 1962.

A solvolytic deoxymercuration has been discovered—that of 2-iodomercuriethyl esters. Solvolysis rate constants for the benzoate in mixtures of water with 30% or more of dioxane, ethanol, or acetic acid are linearly related to the Grunwald-Winstein Y's. For the acetate, solvolysis rate constants are linearly related to the Grunwald-Winstein Y's in all mixtures of ethanol and dioxane with water, but no linear relation exists over any substantial range of acetic acid-water mixtures. With both compounds a separate slope (m) is obtained for each organic diluent. These results are interpreted in terms of the mechanism of the deoxymercuration reaction and the structure of the transition state. (Contractor's abstract)

2048

Minnesota U. School of Chemistry, Minneapolis.

INDUCTIVE AND RESONANCE EFFECTS ON DEOXYMERCURATION RATES, by L. L. Schaleger, M. A. Turner and others. [1962] [23]p. incl. diagr. tables, refs. (AFOSR-2732) (AF 49(638)711) AD 438552 Unclassified

Also published in Jour. Org. Chem., v. 27: 3421-3425, Oct. 1962.

Second-order rate constants, k_2, have been measured for deoxymercuration by nonhalogen acid of 14 oxymercurials, $RCH(OCH_3)CH_2HgI$, and 5 oxymercurials, $RCH(OH)CH_2HgI$. For the methyl ethers an excellent correlation (with $\rho^* = -2.77$) between $\log k_2$ and the Taft σ^*'s is obtained when $R = XCH_2$. Compounds in which R is an α,β-unsaturated group give substantial resonance effects. Compounds in which R has other than 2 α-hydrogen atoms seem to give rise to a Baker-Nathan effect with $n = 0.28$, but the effect is relatively small and the point for $R = H$ is an exception. The data for the alcohols is consistent with a similar pattern. These results preclude a transition state closely resembling the protonated starting state and are consistent with a transition state intermediate between protonated starting state, the olefin-mercuric monoiodide complex plus methanol, and the carbonium ion plus methanol. (Contractor's abstract)

2049

Minnesota U. [School] of Chemistry, Minneapolis.

USE OF ELECTROSTATIC VARIATION PRINCIPLES IN MOLECULAR ENERGY CALCULATIONS. by D. M. Schrader and S. Prager. [1962] [5]p. incl. tables. (AFOSR-2802) (AF 49(638)720) AD 278445 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1456-1460, Oct. 1, 1962.

The Thomson and Dirichlet principles of electrostatics have been applied to the evaluation of electron-interaction terms occurring in molecular-energy calculations. A suitable choice of certain trial electric fields and electrostatic potentials permits these terms to be approximated both from above and from below. These approximate calculations of electronic interaction terms may often be considerably easier to perform than the exact evaluations required when molecular energies are obtained in the usual way through the minimum-energy principle. At the same time, when the upper and lower bounds obtained by the present method are properly inserted into the total-energy expression, the validity of the minimum-energy principle is preserved, so that any parameters appearing in the trial wave function can still be evaluated by the usual energy minimization procedure. For illustration, the method has been applied to the calculation of the ground-state energy of molecular hydrogen. (Contractor's abstract)

2050

Minnesota U. [School] of Chemistry, Minneapolis.

DIFFUSION AND VISCOUS FLOW IN CONCENTRATED SUSPENSIONS. by S. Prager. June 1962. 18p. (Technical rept. no. 4) (AFOSR-2803) (AF 49(638)720) AD 278446 Unclassified

Also published in Physica, v. 29: 129-139, Feb. 1963.

The principle of minimum entropy production is applied to obtain bounds on the diffusion coefficient of a solute in a suspension of solid particles, as well as on the viscosity of the suspension. These bounds involve certain 2 and 3-point correlations characterizing the geometry of the liquid-solid interface, but are not in any way dependent upon the adoption of a simplified model to represent the system. In particular, it is not necessary to assume that the suspended particles are too far apart to interact with one another, and the theory is therefore valid even when the volume fraction of solid is high. (Contractor's abstract)

2051

Minnesota U. School of Chemistry, Minneapolis.

BROWNIAN MOTION ON MANY PARTICLE SYSTEMS, by S. Prager and G. Woodbury. [1962] [3]p. (AFOSR-J651) (AF 49(638)720) AD 415429 Unclassified

Also published in Jour. Chem. Phys., v. 38: 1446, Mar. 15, 1963.

Variational methods were recently used to obtain upper bounds on the diffusion rates of solutes through suspension of impenetrable particles. The same approach was applied to large groups of interacting particles diffusing under the influence of external forces.

2052

Minnesota U. School of Chemistry, Minneapolis.

COMPLEX REFRACTIVE INDEX OF AN IDEAL MONATOMIC GAS, by C. A. Mead. [1962] [6]p. (AFOSR-2196) (AF 49(638)940) AD 611743 Unclassified

Also published in Phys. Rev., v. 128: 1753-1758, Nov. 15, 1962.

The main results of some previous work of the author on this subject are rederived in a more rigorous fashion. In particular, no appeal is made to perturbation theory or to the author's "damping operator" formalism, and closer attention is paid to the question of proper averaging over configurations of absorbers. All effects due to translational motion of absorbers are neglected, but the dipolar "resonance" interactions are included. It is shown that the formal results of the previous work, which permit a detailed calculation of the absorption line shape, are valid under the following assumptions: (a) The average optical behavior of the gas is describable in terms of a refractive index, and (b) there is no correlation between the positions of different absorbers, i.e., the gas is ideal. However, it is also shown that the cutoff procedure for handling a divergent integral which appears in the theory must be modified. The modified cutoff procedure leads to a large increase in the theoretically predicted linewidth, in qualitative agreement with experiment. (Contractor's abstract)

2053

Minnesota U. School of Chemistry, Minneapolis.

THEORETICAL STUDIES OF ABSORPTION LINE SHAPES. by C. A. Mead. Final rept. Oct. 25, 1962. 2p. (AFOSR-3786) (AF 49(638)940) Unclassified

Achievements obtained under this contract are summarized. Included are a contribution to the theory of absorption by excitons in solids and a solution to the previous problem of correct averaging in calculating line shapes in gases in the static limit. References to the published literature resulting from these works are cited. Research is being carried forward on the problem of line shapes in monatomic and diatomic gases with translational motion of the absorbers taken into account as well as the dipolar forces between them.

2054

Minnesota U. School of Chemistry, Minneapolis.

THEORY OF ABSORPTION LINE SHAPES IN MONATOMIC GASES. I. GENERAL FORMULATION AND APPROXIMATE SOLUTIONS, by H. Takebe, G. P. Reck, and C. A. Mead. [1962] 37p. incl. diagrs. (AFOSR-4869) (AF 49(638)940) AD 414123 Unclassified

A formalism is developed for calculating the complex refractive index of a monatomic gas as a function of frequency in the region of an absorption. The treatment involves a direct study of the properties of the dressed photon state in the gas, and includes effects due to translational motion of the atoms as well as the dipolar resonance interactions between them. It is necessary to assume that the electromagnetic properties of the gas are describable in some detail by a linear frequency- and wave-number-dependent susceptibility. A set of coupled nonlinear integral equations are derived which together determine the susceptibility function and hence the observable refractive index. The static limit of large atomic mass is considered in some detail, and a first correction to it is also obtained. The results are compared with measurements by Tomiser on the linewidths of the sodium D-line at various temperatures and pressures. Qualitative agreement was obtained, while previous theoretical linewidths were too small by a factor of order 1000. (Contractor's abstract)

2055

Minnesota U. School of Chemistry, Minneapolis.

THEORY OF ABSORPTION LINE SHAPES IN MONATOMIC GASES. II. METHOD OF "QUASI-MOMENTS", by C. A. Mead. [1962] 28p. incl. diagrs. refs. (AFOSR-4870) (AF 49(638)940) AD 413810 Unclassified

The Kronig-Kramers theorem leads to a relation between the coefficients in an asymptotic expansion of the refractive index in the far wings of an absorption line and certain integral properties, called quasi-moments, of the absorption line. The quasi-moments, or Q-moments, are related to the ordinary moments when the latter exist, and can be qualitatively related to such commonly measured quantities as the half width. Since the asymptotic coefficients are relatively easy to evaluate this leads to a simple way of getting theoretical predictions for some properties of the line shape. The method is applied to the theory of a preceding paper, and results are obtained which are in qualitative agreement with experimental linewidths. It is also possible to take into account the correction to the strong linearity assumption made previously. The correction leads to a narrowing of the line ('non linear narrowing') which is in the right direction to remove the remaining discrepancy between theory and experiment.

2056

Minnesota U. School of Chemistry, Minneapolis.

STUDIES OF POINT DEFECTS IN MAGNESIUM OXIDE, by J. E. Wertz, G. Saville and others. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0745) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-54 and Nadonal Science Foundation) AD 436513 Unclassified

Presented at Internat'l. Conf. on Crystal Lattice Defects, Kyoto (Japan), Sept. 7-12, 1962.

Also published in Jour. Phys. Soc. Japan, v. 18, Suppl. II: 305-311, M r. 1963.

This study is an attempt to correlate optical absorption bands in single magnesium oxide crystals with point defects known to exist from electron spin resonance observations. Optical measurements in the range 4000 to 50,000 cm^{-1} were made on crystals as received after heat treatments, after ultraviolet or x-irradiation, and after neutron irradiation with subsequent heat treatment or irradiation. The goal has been the assignment of optical bands as due to impurities in particular valence states, to trapped hole centers or trapped electron centers. Some progress has been made by comparison of optical and ESR spectra on the same crystals. The best point defect for which the correlation of behavior of the 2 types of spectra is the single hole trapped on an oxygen ion adjacent to a positive ion vacancy. The absorption band which is ascribed to this center occurs at 18,500 cm^{-1}, and is responsible for the fleeting violet color of MgO crystals upon irradiation. While neutron irradiation, gives rise to F-centers (electron trapped at negative ion vacancies) and to visible coloration, no assignment of optical bands with particular electron trapping centers has yet been made. (Contractor's abstract)

2057

Mississippi U. Dept. of Chemistry, University.

A METHOD FOR SOLVING THE GENERAL FORMS OF THE GRUNWALD-COBURN SPECTROPHOTOMETRIC EQUATIONS, by P. A. D. de Maine. [1962] [4]p. (AFOSR-4313) (AF AFOSR-62-19) Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 8: 237-240, 1962.

A method of calculating the parameters which define the system of reversible competitive reactions: $n_1S \overset{K_1}{=} X$, $n_2T \overset{K_2}{=} Y$, $n_3S + n_4T \overset{K_3}{=} Z$, with spectrophotometric data is discussed. Only one parameter (n_3 of n_4) need be specified. (Contractor's abstract)

3058

Mississippi U. Dept. of Chemistry, University.

QUANTITATIVE CRYOSCOPIC METHOD FOR TESTING SPECTROPHOTOMETRIC EVIDENCE OF REVERSIBLE ONE-ONE COMPLEX FORMATION IN NON-IDEAL SOLUTIONS, by P. A. D. de Maine. [1962] [3]p. (AFOSR-4314) (AF AFOSR-62-19) Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 8: 241-243, 1962.

The quantitative comparison of thermodynamic constants, determined by spectrophotometric and nonspectrophotometric methods, for reversible 1 to 1 complex formation between unlike molecules continues to be the most important task that must be accomplished before rapid progress on the theory of solution processes can be made. For ex spectrophotometric studies of complex formation between iodine and other molecules in solution suggest that a quantitative nonspectrophotometric method for studying these solutions would be useful. A crysocopic method, is described for application to nonideal solutions.

2059

Mississippi U. Dept. of Chemistry, University.

INFRARED ABSORPTION SPECTRA FOR ALCOHOLS AND ETHERS DISSOLVED SEPARATELY OR TOGETHER IN CARBON TETRACHLORIDE, by M. S. Smith, P. A. L. de Maine, and M. M. de Maine. [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-4315) (AF AFOSR-62-19) Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 8: 244-260, 1962.

Quantitative infrared absorption spectra (between 650 cms^{-1} and 4000 cms^{-1} of alcohols (MeOH, i-PrOH, n-PrOH, n-AmOH, 3-heptanol and phenyl-ethyl alcohol) and ethers (Et_2O, i-4 dioxane, bis (2 methoxy) ethyl ether, anisole and p-bromo-phenyl phenyl ether) dissolved separately or together in carbon tetrachloride at 30 ± 2°C have been measured. Centers of all bands except those due to hydrogen bond formation (3100 to 3600 cms^{-1}) do not shift measurably (± 1 cm^{-1} up to 2000 cms^{-1}; ±4 cms^{-1} above 2000 cms^{-1}) in both the separate and combined systems over the entire concentration ranges studied. Limiting values for the hydrogen bond bands (3360 ± 10 and 3520 ± 10 cms^{-1}) are independent of the alcohol and/or ether used. The equation: $N(ROH) \overset{K}{\rightleftharpoons} (ROH)_N$, has been solved for K and N by a computer method with data for both the alcohol-CCl_4 and alcohol-ether-CCl_4 systems. The product, KN, is used to set up a relative scale of hydrogen bond strengths in alcohol solutions. (Contractor's abstract)

2060

Mississippi U. Dept. of Chemistry, University.

SOLVENT EFFECTS ON CHARGE-TRANSFER COMPLEXES. I. THE S-TRINITROBENZENE-NAPHTHALENE COMPLEX IN CARBON TETRACHLORIDE, N-HEPTANE, N-HEXANE, CYCLO-HEXANE, CHLOROFORM, OR CARBON DISULFIDE, by C. C. Thompson, Jr. and P. A. D. de Maine. 1962, 28p. incl. diagr. tables, refs. (AFOSR-4832) (AF AFOSR-62-19) AD 416143 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 3096-3101, Oct. 20, 1963.

Formation constants and absorptivities for the 1:1 s-trinitrobenzene-naphthalene complex in 6 inert solvents (CCl_4, n-hexane, cyclohexane, n-heptane, $CHCl_3$, or CS_2) were calculated with spectrophotometric data collected at 15 wavelengths between 3300 and 4000A at 20° and 45°C. Absorptivities for the complex at the absorption maxima (near 3600A) at 20°C vary from 1294 (± 22) for n-heptane to 1540 (± 13) for n-hexane. As the temperature is increased from 20° to 45°C, the absorptivities decrease by approximately 10% except in $CHCl_3$ systems where those between 3650 and 4000A are unchanged. The formation constant (K) is independent of wavelength at each temperature in all solvents except n-heptane where at 20°C, K, in mol/liter units, it is 9.58 (± 0.17) for wavelengths between 3300 and 3700A, and gradually increases to 14.61 (± 0.17) at 4000A. At 45°C, K in n-heptane is 6.12 (± 0.09) at wavelengths up to 3850A, and it increases to 8.27 (± 0.09) at 4000A. Average values for K at 20°C vary from 1.82 (± 0.08) in $CHCl_3$ to 9.58 (± 0.17) in n-heptane. However, the heat of complex formation appears to be independent of the inert solvent with a median value near - 3.0 kcal/mol except for cyclohexane where the value is - 4.16 (± 0.63) kcal. Recent developments in theories of complex formation are examined. Variation of K with wavelength and of absorptivities with temperature are attributed to simultaneous higher order reactions. (Contractor's abstract)

2061

Missouri U. [Dept. of Mathematics] Columbia.

ON THE RANGE OF THE DIFFERENCE BETWEEN HYPOTHETICAL DISTRIBUTION FUNCTION AND PYKE'S MODIFIED EMPIRICAL DISTRIBUTION FUNCTION, by H. D. Brunk. [1961] [8]p. incl. tables, refs. (AFOSR-3609) (AF 49(638)754) Unclassified

Also published in Ann. Math. Stat., v. 33: 525-532, June 1962.

For abstract see item no. 1940, Vol. V.

2062

Missouri U. [Dept. of Mathematics] Columbia.

ON AN EXTENSION OF THE CONCEPT CONDITIONAL EXPECTATION, by H. D. Brunk. [1962] [7]p. [AF 49-(638)754] Unclassified

Published in Proc. Amer. Math. Soc., v. 14: 298-304, Apr. 1963.

Let (Ω, S, μ) be a complete measure space, let the equivalence classes of S-measurable functions be called random variables, and let L_1 and L_2 be the classes of integrable and square integrable random variables. Let $\mathcal{L}$ be a sub-σ-lattice of S containing φ and Ω and call f $\mathcal{L}$-measurable if $[f > a] \in \mathcal{L}$ for every real a. Let $R(\mathcal{L})$ denote the class of $\mathcal{L}$-measurable random variables and let $L_i(\mathcal{L}) = L_i \cap R(\mathcal{L})$, i = 1, 2. Let $\mathcal{B}'$ denote the class of Borel sets of reals which exclude the origin. In this paper the author improves upon results of his in which μ is assumed finite and of Šidák in which $\mathcal{L}$ is a σ-field. Five theorems are stated and proved. Theorem 1 states (in part) that if $X \in L_2$ then there is a unique $Y \in L_2(\mathcal{L})$ (called the conditional expectation) such that $\int XZ\, d\mu = \int YZ\, d\mu$ for all $Z \in L_2(\mathcal{L})$ and $B \in Y^{-1}(\mathcal{B}')$, $\mu(B) < \infty \Rightarrow \int_B X\, d\mu = \int_B Y\, d\mu$, and that if also $X \in L_1$, then $Y \in L_1$, and this equality holds for all $B \in Y^{-1}(\mathcal{B}')$. Theorem 2 presents a similar result for $X \in L_1$, $Y \in L_1(\mathcal{L})$. Theorem 3 states that if $\mathcal{L}$ is also a sub-σ-field of S, then $E(\cdot\,|S)$ is the unique continuous extension to L_1 of projection in L_2 on $L_2(\mathcal{L})$. Let F be an arbitrary family of random variables and let $M \subset L_2$. Theorems 4 and 5 give necessary and sufficient conditions that there exist σ-lattices L_1 and $\mathcal{L}_2$ containing ω and Ω such that $R(\mathcal{L}_1) = F$ and $L_2(\mathcal{L}_2) = M$. (Math. Rev. abstract)

2063

Montreal U. Inst. of Experimental Medicine and Surgery (Canada).

SYMBOLIC SHORTHAND SYSTEM FOR PHYSIOLOGY AND MEDICINE, by N. Padmanabhan and G. Ember. [1962] [5]p. incl. diagrs. (AFOSR-J711) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-356 and Gustavus and Louise Pfeiffer Research Foundation) AD 415397 Unclassified

Also published in Methods Inform. Med., v. 1: 138-142, Oct. 1962.

The symbolic shorthand system (SSS) is applicable to any problem of documentation. Instead of a code designation composed of numbers and letters, the SSS uses mnemonic symbols and signs reminiscent of the subjects they denote. All possible subjects and relationships between them are first arranged in 1 dimension, typed separately on subject cards, and then arranged 1 after the other according to a fixed order of precedence. Synonymous designations are avoided because all symbols have only 1 fixed meaning. The possibility of combining symbols gives this system the vital flexibility that other methods lack and it can be expanded indefinitely by establishing new symbols and signs. (Contractor's abstract)

2064

National U. de la Plata. Dept. of Physics (Argentina).

BACKSCATTERING EFFECT ON GAMMA-RAY SPECTRA RECORDED BY SCINTILLATION SPECTROMETERS, by H. E. Bosch and M. C. Caracoche. [1962] [6]p. incl. diagrs. table. (AFOSR-64-556) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR 30-9 and Consejo Nacional de Investigaciones Científicas Y Técnicas) Unclassified

Also published in Nuclear Instr. and Methods, v. 22: 77-82, Mar. 1963.

Gamma radiation spectra emitted by standard nuclides are recorded by a scintillation spectrometer coupled to a multichannel pulse height analyzer. The variation in intensity of the backscattering peak is studied as a function of the source-to-crystal distance, for different energies, with and without a lead housing. The effect of the interposition of a collimator between source and crystal is also analyzed. Finally, the variation in peak intensity of the backscattering effect through addition of different thicknesses of aluminum and beryllium in the source backing is considered. The optimum geometry for recording electromagnetic radiation spectra is indicated. (Contractor's abstract)

2065

National U. de la Plata. Dept. of Physics (Argentina).

BETA SPECTROSCOPY WITH SOLID STATE DETECTORS, by H. [E.] Bosch, F. Krmpotic and A. Plastino. [1962] [14]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR 61-39] Consejo Nacional de Investigaciones Científicas Y Técnicas, and Comision Nacional de Investigaciones Espaciales) Unclassified

Also published in Nuclear Instr. and Methods, v. 23: 79-92, May 1963.

The optimum conditions are described for registering beta spectra and detecting conversion electrons with solid state counters. The error in determining the beta spectra energies from standard sources is pointed out. A fast-slow coincidence circuit is set up for detecting conversion electrons in coincidence with electromagnetic radiations by means of a system with solid state counter and scintillation crystal. The results obtained in the case of Bi^{207}, Cs^{137}, Au^{198}, and Pb^{203} are given. (Contractor's abstract)

2066

Naples U. (Italy).

SOLUTION OF THE SUPERSONIC FLOW OF A NON-PERFECT GAS AROUND POINTED THREE-DIMENSIONAL BODIES BY THE LINEARIZED CHARACTERISTICS METHOD, by L. G. Napolitano. Final rept. Aug. 31, 1962, 38p. (AFOSR-4364) (AF 61(052)82) AD 294840 Unclassified

In the present report it is proved that the linearized characteristic method, devised by Ferri for perfect gas flows, can be extended to deal with fluids obeying the most general state equations. A pointed 3-dimensional body of arbitrary geometry differing from conical shape by a series of first order small terms has been considered explicitly. The thermodynamic characterization of the fluid has been expressed all in terms of appropriate thermodynamic derivatives of the fundamental relation (i. e. the first order homogeneous function giving the specific energy in terms of the entropy and of the specific volume) which has been left unspecified, and thus completely arbitrary, throughout. Shock matching boundary conditions and complete solution of the linearized equations between the shock and the body have been derived and discussed. The development has been carried down to workable relations. The present method starts finding its most useful applications from the moment in which real gas effects begin to appear and continues all the way up in the realm of dissociating, reacting and/or relaxing flows when equilibrium conditions can be assumed. (Contractor's abstract)

2067

Naples U. Inst. of Aeronautics (Italy).

LINEARIZED STEADY MOTION OF PLURI-REACTING MIXTURES, by L. G. Napolitano. [1962] [2]p. (AFOSR-64-2236) (AF 61(052)327) AD 452414 Unclassified

Also published in AIAA Jour., v. 1: 230-231, Jan. 1963.

Presentation of a proof for 2 similar statements on the linearized steady motion of a mixture in which n reactions take place. The statements are: (1) when all pertinent relaxation times are much smaller than the macroscopic characteristic time, the linearized steady flow of a multireacting mixture is equivalent to that of an inert gas mixture with a volume viscosity depending on the equilibrium state of the mixture; and (2) when m relaxation times ($1 \leq m < n$) are much smaller than the macroscopic characteristic time, the linearized steady flow of an n reacting mixture is equivalent to that of a viscous mixture in which (n-m) reactions take place, the equivalent kinematic volume viscosity being the same as that for case (1).

2068

Naples U. [Inst. of Theoretical Physics] (Italy).

THE IMITATION OF NATURAL AUTOMATA (THREE PORTRAITS OF A BRAIN), by V. Braitenberg. [1959] [6]p. (AFOSR-1294) (AF 61(052)96) AD 262252 Unclassified

Also published in Riv. Methodos, v. 11: 1-6, 1959.

Three different models of the brain are described. The first of these models of machines is the Darwinian machine or rigid brain. This is an ancestral machine made of sense organs, motor organs, a classifying organ, its mirror image, or declassifying organ, and a system of random connections. The second machine

is known as the coincidence detector and consists of 2 equal parts simply called left (L) and right (R , which are both connected to a central part, or organ of association. Two phases may be distinguished in the life of this machine. These are the infancy phase during which the machine just learns without working and the working phase during which one of the 2 parts (L or R) receives the input while the output emanates from the other. The third machine is known as the Freudian machine. The function of this brain is regulated by the following characteristics: (1) In each unit of time, the brain passes from one state to the other; (2) For each constellation of input in the sensory organs, there is a class of states of the brain compatible with that input, and another class of states that is incompatible; and (3) A constellation of activity in the motor organs corresponds to each state of the brain. Given a state S, the choice of the following state S' is regulated by the compatibility with the input already mentioned; the structure of the machine; the frequency of the transition S-S' in the past; and the advantage conferred by the transition S-S'.

2069

Naples U. [Inst. of Theoretical Physics] (Italy).

NEURAL MECHANISM OF CEREBELLAR FUNCTION, by V. Braitenberg. Final rept. June 1962, 9p. (AFOSR-3033) (AF 61(052)96) AD 290196 Unclassified

The objective of this investigation is to show that the cerebellar cortex acts as a timing organ. The available clinical and electrophysiological data will be analyzed from this point of view and if possible, a theory will be formulated to integrate these observations. Mathematical formulations will be attempted to describe input-output relationships in the cerebellar cortex. The timing of the arrival of impulse volleys at different anatomical sites will be correlated with the distances travelled.

2070

Naples U. [Inst. of Theoretical Physics] (Italy).

CALCULATION OF BAND STRUCTURE OF COMPLEX CRYSTALS BY THE FREE ELECTRON NETWORK MODEL, by G. Della Riccia. Mar. 1962 [13]p. incl. diagrs. (Technical note no. 5) (AFOSR-2532) (AF 61-(052)434) AD 289467 Unclassified

The mathematical formalism of the method for obtaining the complete band structure of a crystal and the band structure of complex crystals is presented. Application is made to the crystals of the diamond type (p = 1, 2 parameters) and to the complex crystals II-IV, such as Mg_2Sn (p = 2, 4 parameters). The physical assumptions which are at the base of this approximation method are also presented. In conclusion, the band structure in the FEN (free electron model in a lattice network) approximation is given by the variation against the wave vector $\vec{k}$, of the electron kinetic energy E on the branches of the network which are considered as lines of density current of the presence probability of electrons.

2071

Naples U. Inst. of Theroetical Physics (Italy).

SELF COUPLED MESON FIELD: EQUATIONS FOR SINGLE PROPAGATORS, THEIR SOLUTION FOR A NUMERICAL MODEL, CONSIDERATIONS ON THE CONVERGENCE OF PERTURBATIVE EXPANSIONS, by E. R. Caianiello and A. Campolattaro. July 1962 [18]p. incl. refs. (Technical note no. 7) (AFOSR-3103) (AF 61(052)434) AD 281803 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 390-400, Oct. 16, 1962.

It is shown that all the independent equations, or conditions, that can be derived for a single propagation kernel from all the branching equations that connect it and its derivatives with respect to the parameters of the theory with kernels of arbitrarily high order reduce to a small and unique set. It is then shown that whereas the only information obtainable from the majoration of a regularized perturbative expansion of the kernels is that all majorants are divergent, a numerical model obtained by imposing that the free propagators in configuration space depend only upon the mass can be exactly solved if these equations are used. It is found that the general solution is a linear combination of hypergeometric functions of the coupling constant λ which is singular for $\lambda = 0$; there is, however, a unique choice of constants which yields a solution regular when $\lambda = 0$. This model is related to the asymptotic form of the correct theory if the latter is defined over an infinitesimal space-time volume. (Contractor's abstract)

2072

Naples U. Inst. of Theoretical Physics (Italy).

ASYMPTOTIC CONVERGENCE OF RENORMALIZED PERTURBATIVE EXPANSIONS, by E. R. Caianiello. July 30, 1962, 7p. (Technical note no. 8) (AFOSR-3543) (AF 61(052)434) AD 285275 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 998-1002, Dec. 1, 1962.

It is proved that the renormalized perturbative expansions of propagation kernels in configuration space, for finite space-time volume of integration, are asymptotically convergent in the sense of Poincaré, if it is assumed that the kernels themselves are continuous functions of the expansion parameter in a neighborhood of the value of the parameter for which the expansions are made.

2073

Naples U. Inst. of Theoretical Physics (Italy).

THE RENORMALIZATION GROUP, by E. R. Caianiello. Aug. 1962, 25p. incl. diagrs. refs. (Technical note no. 8) (AFOSR-3714) (AF 61(052)434) AD 285430 Unclassified

Also published in Group Theoretical Concepts and Methods in Elementary Particle Physics; Lectures of the Instanbul Summer School of Theoretical Physics, Ankara (Turkey) (July 16 - Aug. 4, 1962), ed. by F. Gürsey. New York, Gordon and Breach, v. 1: 409-425, 1964.

The dynamics and structure of field theories were studied with particular consideration of the renormalization group. Electrodynamics was treated as an example, and the bases for u-v divergences were investigated.

2074

Naples U. Inst. of Theoretical Physics (Italy).

NOVEL METHODS OF CALCULATION APPLIED TO SEMICONDUCTOR PHYSICS, by E. R. Caianiello. Final rept. Sept. 1962, 10p. (AFOSR-3769) (AF 61-(052)434) AD 289331 Unclassified

The purpose of this proposed research was to establish rigorous mathematical equations and methods for handling problems which occur whenever many particles have to be considered. This is the case both in many-body physics and in field theory; recent advancements have shown the advantage of treating both subjects by means of a unified technique, that which uses Green's functions, called propagation kernels. Although the problems of field theory and of many-body physics need different emphases on different parts of this formalism, it is an interesting characteristic of the formal theory of propagators. It consents to treat in a unified manner all such questions until the very point of computation. It offers furthermore the advantage that insight for further elaboration of ideas can thus come from different realms of physical intuition. (Contractor's abstract)

2075

Naples U. Inst. of Theoretical Physics (Italy).

RENORMALIZATION GROUP AND COMPLETENESS OF FIELD THEORIES. NUCLEON-PION COUPLINGS, by E. R. Caianiello and M. Marinaro. Aug 1962 [32]p. (AFOSR-4579) (AF 61(052)434) AD 401374 Unclassified

Also published in Nuovo Cimento, Series X, v. 27 1185-1207, Mar. 1, 1963.

The problem of the mathematical consistency of a field theory defined by a given local Hamiltonian is studied in terms of the propagator (Green's function) formalism. It is necessary for the mathematical consistency of a theory that all the branching equations satisfied by its propagators be covariant under the transformations of its renormalization group (which can be explicitly written). This analysis (which differs in method, but not in principle, from the standard renormalization program) permits to find systematically and explicitly all the terms that need be added to the original Hamiltonian if this was not complete to start with, i.e. if covariance could not be secured for the set of branching equations obtained from it alone. Local non-renormalizable theories are mathematically meaningless, because they originate from only fragments of Hamiltonians which are meaningful only if taken as wholes; the missing terms (even if infinite in number) can be exactly reconstructed with the present method, which leads naturally to identify the concepts of mathematical consistency and of physical completeness. All meaningful relations among coupling constants, such as symmetry requirements, must remain invariant under the renormalization group, which plays a role as important in the search for completeness, as that of the gauge groupe in electrodynamical problems. For the sake of concreteness, and as a first example, this method is illustrated with reference to the study of the standard meson-nucleon couplings, scalar and pseudoscalar, neutral and charged; the well known σ^3 and σ^4 (scalar), σ^4 (pseudoscalar) terms are obtained (a precedent erroneous statement about the renormalizability of the neutral scalar coupling is corrected, so that now all results agree with the expected ones).

2076

Naples U. [Inst. of Theoretical Physics] (Italy).

CALCULATION OF BAND STRUCTURE OF COMPLEX CRYSTALS BY THE ELECTRON NETWORK MODEL, by G. Della Riccia. July 1962 [4]p. incl. diagrs. (AFOSR-4597) (AF 61(052)434) Unclassified

The method of the electron in a network lattice permits calculation of the complete band structure of a complex crystal. one establishes explicitly a particular equation for each set of bands of the same type of symmetry. Besides the simplicity of the calculation, 2 advantages of such a method are the possibility of taking easily into account the influence of the atoms which are not merely the first neighbors, and the fact that the lattice potentials appear in the equations only as Dirac's functions. (Contractor's abstract, modified)

2077

Naples U. Inst. of Theoretical Physics (Italy).

INTERFERENCES AMONG FEYNMAN GRAPHS OF DIFFERENT TOPOLOGY, by E. R. Caianiello and K. Y. Shen. [1961] [4]p. (AFOSR-64-0447) (AF 61-(052)434) AD 436174 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 1038-1041, June 1, 1961.

For abstract see item no. 1949, Vol. V.

2078

Naples U. Inst. of Theoretical Physics (Italy).

NEUTRAL SCALAR Z-MESON AND THE MASS DIFFERENCE BETWEEN MUON AND ELECTRON, by K. Tanaka. [1961] [8]p. (AFOSR-64-0454) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)434 and Atomic Energy Commission) AD 435918

Also published in Nuovo Cimento, Series X, v. 21: 169-176, July 1, 1961.

For abstract see item no. 1951, Vol. V.

2079

National Bureau of Standards, Washington, D. C.

THE EMISSION SPECTRUM OF THE HYDROGEN-FLUORINE FLAME (Abstract), by D. E. Mann and J. J. Ball. [1956] [1]p. [CSO-680-56-31] Unclassified

Presented at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 11-15, 1956.

Published in Spectrochim. Acta, v. 8: 292, Nov. 1956.

The emission spectrum of the hydrogen-fluorine flame has been photographed over the range 5500-10,400 A with a 2-metre grating spectrograph. The 3-0, 4-1, 5-2, 4-0, 5-1, 6-2, 7-3, 5-0, 6-1, 7-2, 8-3, and 9-4 bands of hydrogen fluoride have been measured. For several bands, levels above J = 20 have been observed. These data have permitted improved molecular constants to be established.

2080

National Engineering Science Co., Pasadena, Calif.

GENERALIZATION OF A METHOD OF POTENTIALS FOR THE VECTOR WAVE EQUATION OF ELASTICITY FOR INHOMOGENEOUS MEDIA, by J. F. Hook. [1962] [1]p. (AFOSR-1977) (AF 49(638)1082) Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 34: 354-355, 1962.

In a recent paper, the Helmholtz method of potentials was generalized for application to the vector wave equation of elasticity for certain types of inhomogeneous media. Only the cases of 3-dimensional axially symmetric waves and 2-dimensional waves were treated. It is shown in this paper that these restrictions on wave symmetry can be removed, so that the method is applicable for waves of general spatial variation. (Contractor's abstract)

2081

National Engineering Science Co., Pasadena, Calif.

AXIALLY SYMMETRIC ELASTIC WAVES IN AN UNBOUNDED INHOMOGENEOUS MEDIUM WITH EXPONENTIALLY VARYING PROPERTIES, by M. H. Lock. [1962] [12]p. incl. diagrs. (AFOSR-5084) (AF 49(638)-1082) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 527-538, Apr. 1963.

The propagation of elastic waves in a traversely inhomogeneous medium of infinite extent is studied. A method to separate the governing equations of motion is described and solutions are obtained for the elastic waves generated by an impulsive P type point source. These solutions are compared with the corresponding solution for the homogeneous case and the various effects introduced by the inhomogeneity of the medium are discussed.

2082

National Engineering Science Co., Pasadena, Calif.

A THEORETICAL STUDY ON PROPAGATION OF SEISMIC WAVES IN AN INHOMOGENEOUS EARTH, by J. F. Hook, M. H. Lock, and T. Karlsson. Semi-annual technical summary rept. June 15, 1962, 15p. (AF 49(638)1082) AD 284379 Unclassified

The major objectives are to develop the method of potentials for application to the vector wave equation of elasticity for inhomogeneous media, to formulate and solve representative boundary and initial value problems of propagation in inhomogeneous media, and to discuss their application to problems of propagation in the earth. (Contractor's abstract)

2083

[National Research Council. National Academy of Sciences, Washington, D. C.]

MEETING OF AD HOC COMMITTEE ON NOMENCLATURE OF STEROIDS, Columbus, Ohio. Oct. 13-15, 1961 [38]p. incl. diagrs. (AFOSR-2077) (AF AFOSR-61-103) Unclassified

The purpose of this meeting was to discuss the tentative recommendations of the IUPAC Steroid Nomenclature Subcommittee as published in the IUPAC Information Bulletin No. 11 (October 1960). Some of the rules discussed are: (1) nomenclature of antipodes and racemates, (2) open-side chains, (3) ethanic acid, and (4) additional rings, excluding spirans.

2084

[National Research Council. National Academy of Sciences, Washington, D. C.]

PROCEEDINGS OF ELEVENTH GENERAL ASSEMBLY,

Berkeley, Calif., Aug. 15-24, 1961, ed. by D. H. Sadler. London, Academic Press, 1962, 532p. incl. illus. diagrs. tables, refs. (AFOSR-5133) [AF AFOSR-61-141] AD 415956 Unclassified

Also published in Trans. Internat'l. Astronom. Union, v. 11B: 1-532, 1962.

The early chapters are devoted primarily to the inaugural ceremonies and to principal administrative reports and decisions. Following chapters contain the scientific reports of the joint discussions on these major subjects: (1) Stellar motions and stellar dynamics; (2) Solar magnetic fields; (3) Demands made on celestial mechanics by the preparation of ephemerides; and (4) Problems requiring radio-astronomical observations of high sensitivity and resolution.

2085

Naturalia et Biologia, Paris (France).

[CHARACTERISTICS OF THE EVOKED RESPONSES IN THE PONTINE RETICULAR FORMATION IN THE CAT] Caractéristiques des réponses évoquées dans la formation réticulée pontique chez le Chat, by P. Bach Y Rita. [1962] [2]p. incl. illus. (AFOSR-J637) (AF 61-(052)475) AD 414070 Unclassified

Also published in Compt. Rend. Séances Soc. Biol., v. 156: 1228-1230, July 7, 1962.

Two types of responses were observed in experiments carried out on 41 cats, anesthetized with chloralose. The first type was observed in the mesencephalic or bulbar reticular regions, was of short duration, and was brought about by visual and auditory stimulation. The second type was observed in the median part of the brain, was of very long duration and was obtained by bilateral stimulation.

2086

[Naturalia et Biologia] Paris (France).

[EFFECT OF TELENCEPHALIC ABLATIONS ON THE AMPLITUDE OF EVOKED POTENTIALS IN THE CENTER MEDIAN BY SOMATIC STIMULATION] Effet d'ablations télencéphaliques sur l'amplitude des potentiels évoqués dans le centre médian par stimulation somatique, by M. Meulders, J. Massion and others. [1962] [10]p. incl. illus. refs. (AFOSR-J638) (AF 61-(052)475) AD 414072 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol., v. 15: 29-38, Feb. 1963.

Potentials evoked in the center median (CM) by somatic stimuli undergo a marked increase in amplitude when the animal passes from the waking state to chloralose-induced anesthesia. Systematic determinations in 16 cats showed that this increase in amplitude is between 80-100%. Wide telencephalic ablations were made under ether anesthesia. In these animals, the evoked response in the CM is maximal from the outset and is not modified by the administration of an anesthetic dose of chloralose. In the awake intact or thalamic animal, both external and receptive stimulation of the midbrain reticular formation, bring about a marked reduction, or even suppression of the responses in the CM. On the other hand, under chloralose anesthesia, only reticular stimulation is effective in producing a reduction in amplitude. The following points are discussed: (1) What are the telencephalic structures responsible for the control of amplitude in the CM? (2) Are there other structures (sub-telencephalic) which may play a similar role? (3) At what point and by what mechanism is this control exerted? (4) What is its physiological significance? (5) Do analogous phenomena exist in structures other than the CM?

2087

Nebraska U., Lincoln.

THE LIOUVILLE THEOREM FOR A QUASI-LINEAR ELLIPTIC PARTIAL DIFFERENTIAL EQUATION, by E. Bohn and L. K. Jackson. [1961] [6]p. (AFOSR-64-0675) (AF 49(638)506) AD 436107 Unclassified

Also published in Trans. Amer. Math. Soc., v. 104: 392-397, Sept. 1962.

For abstract see item no. 1966, Vol. V.

2088

Nebraska U., Lincoln.

A GENERALIZED SOLUTION OF THE BOUNDARY VALUE PROBLEM FOR $y'' = f(x, y, y')$, by L. Fountain and L. [K.] Jackson. [1961] [22]p. incl. refs. (AFOSR-64-1051) (AF 49(638)506) AD 441495 Unclassified

Also published in Pacific Jour. Math., v. 12: 1251-1272, Winter 1962.

The Perron method of systematically exploiting the properties of subfunctions and super-functions in studying the boundary value problem is considered. Some properties of these functions are given. Most of these properties are analogues of classical properties of convex functions. The Perron method is used to obtain a generalized solution of the boundary value problem. Finally, some conditions are given which are sufficient to guarantee that the generalized solution is the solution of the boundary value problem in the usual sense.

2089

New Hampshire U. [Dept. of Physics] Durham.

INTERACTION BETWEEN COLD PLASMAS AND GUIDED ELECTROMAGNETIC WAVES. II, by L. Mower and S. J. Buchsbaum. [1962] [28]p. incl. diagrs. (AFOSR-2771) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-105, Atomic Energy Commission, Office of Naval Research, and Signal Corps) AD 293998 Unclassified

Also published in Phys. Fluids, v. 5: 1545-1551, Dec. 1962.

The interaction between cylindrically symmetric anisotropic plasma column and bounded electromagnetic waves is analyzed theoretically. The properties of a cylindrical cavity coaxial with a cold plasma column and a coaxial with a static magnetic field are determined. The shift in the resonant frequency of the cavity-plasma system is calculated in the high electron density limit and compared with the numerical solution presented earlier.

2090

[New Mexico U., Albuquerque]

INTELLIGENCE: A CONCEPT IN NEED OF RE-EXAMINATION, by S. Liverant. [1959] [10]p. incl. refs. (In cooperation with Ohio State U., Columbus) [AF 49-(638)33] Unclassified

Published in Jour. Consulting Psychol., v. 24: 101-110, Apr. 1960.

The value of intelligence in understanding and predicting behavior is critically discussed. Problems are explored to reevaluate the concepts involved in the term intelligence.

2091

New Mexico U. Engineering Experiment Station, Albuquerque.

DUAL RADIAL DISLOCATION, by F. D. Ju. June 15, 1962 [89]p. incl. illus. diagrs. tables, refs. (Rept. no. ME-4) (AFOSR-647) (AF 49(638)993 and AF AFOSR-62-208) AD 276749 Unclassified

The generalized theory of elastic dislocation set forth by Ju is applied to a dual radial-cut problem to justify the superposition theory. In addition, various dislocation relations along the cut are considered in order to make a comparison of stress field.

2092

New Mexico U. Engineering Experiment Station, Albuquerque.

STRESS DISTRIBUTION DUE TO A LOGARITHMIC SPIRAL DISLOCATION, by F. D. Ju. Jan. 31, 1962, 58p. incl. illus. diagrs. tables, refs. (Rept. no. ME-3) (AFOSR-904) (AF 49(638)993) AD 272134 Unclassified

The problem of the logarithmic spiral dislocation cut is solved. A new theory and postulations for determining the complex potential functions are presented. The logarithmic form of the multiple-valued term is adopted for its ease of manipulation. The condition on the complex potential functions are such that they are no longer required to vanish at the terminus of the cut; only the displacement is required to be finite there. In the specific problem of the logarithmic spiral dislocation cut, the stress pattern about the inner circumference, from the analytical solution, was observed to be symmetrical about a line which passes through the origin of the circular cutout and the terminus point of the dislocation cut. Since the geometry of the physical problem is anything but symmetrical, the symmetry of the stress pattern is unexpected. The maximum shearing stress is found to be finite at the terminus of the dislocation cut. This phenomenon again contradicts the concept of the wedge action in solids.

2093

New South Wales U. Dept. of Applied Mathematics (Australia).

TWO-BODY METHODS FOR THREE-BODY PROBLEMS, by L. M. Delves and G. H. Derrick. [1962] [27]p. incl. refs. (AFOSR-64-0646) (AF EOAR-62-400) AD 435931 Unclassified

Also published in Ann. Phys., v. 23: 133-159, July 1963.

The equivalent 2-body method first introduced by Wigner for deriving triton wave functions is shown to be obtainable directly from the variation principle for the energy. It is extended to cover the general case on noncentral, hard core interactions, for both the bound state and for scattering states, including the breakup reaction. Methods are given for systematically improving the wave function. (Contractor's abstract)

2094

New York State Psychiatric Inst., N. Y.

RATE OF CO_2 FIXATION IN BRAIN AND LIVER, by C. A. Rossi, S. Berl and others. [1962] [7]p. incl. table, refs. (AFOSR-J248) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-725 National Institutes of Health, and Research Foundation for Mental Hygiene, Inc.) AD 401366 Unclassified

Also published in Life Sci., v. 10: 533-539, 1962.

The rate of CO_2 fixation was measured in cats in vivo after intravenous infusion of $NaHC^{14}O_3$ under steady state conditions. Tissue CO_2, aspartic and glutamic acids, glutamine, ketoglutarate and pyruvate were isolated from brain cortex and liver. With the specific activities of tissue CO_2 as a basis, a rapid CO_2 fixation into liver aspartic acid and a slower fixation into brain cortex aspartic acid was found. The closeness of the specific activities of ketoglutarate and glutamate indicated a rapid equilibrium between these compounds. Further supporting data for the compartmentation of glutamic acid metabolism in the brain were obtained.

2095

New York State Psychiatric Inst., N. Y.

CARBON DIOXIDE FIXATION IN THE BRAIN, by S. Berl, G. Takagaki and others. [1962] [4]p. incl. tables, refs. (AFOSR-J249) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)725, National Institutes of Health, Office of Naval Research, and Research Foundation for Mental Hygiene, Inc.) AD 400849 Unclassified

Also published in Jour. Biol. Chem., v. 237: 2570-2575, Aug. 1962.

Carbon dioxide fixation in brain was studied in cats to which $NaHC^{14}O_3$ with and without ammonia was administered by intracarotid infusion. Glutamic and aspartic acids, glutamine, flutathione, and γ-aminobutyric acid were isolated from blood, brain, and liver, and their specific activities were determined. The data indicate a significant incorporation of CO_2 into the amino acids of the cerebral cortex, presumably by way of the citric acid cycle. Without simultaneous ammonia infusion, the specific activity of aspartic acid is 3 times that of glutamine, whereas in the presence of ammonia the ratios of specific activity of both compounds are closer to unity or reversed. The data suggest that, in the presence of ammonia, the oxaloacetic acid is channeled into glutamine formation. γ-Aminobutyric acid isolated from the tissue, as well as that obtained after decarboxylation of glutamic acid or glutamine, has less than 5% of the counts of the precursor. These findings give additional support to the assumption that the operation of a CO_2 fixation mechanism in brain is similar to that in liver. Additional data on the compartmentation of glutamic acid and glutamine synthesis are presented. The significance of the findings for an interpretation of ammonia metabolism in brain is pointed out. (Contractor's abstract)

2096

New York State Psychiatric Inst., N. Y.

METABOLIC COMPARTMENTS IN VIVO; AMMONIA AND GLUTAMIC ACID METABOLISM IN BRAIN AND LIVER, by S. Berl, G. Takagaki and others. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-J250) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)725, National Institutes of Health, Office of Naval Research, and Research Foundation for Mental Hygiene, Inc.) AD 400851 Unclassified

Also published in Jour. Biol. Chem., v. 237: 2562-2569, Aug. 1962.

The metabolic pathways of $N^{15}H_3$ administered to cats by intracarotid infusion in experiments of short duration is reported. Glutamic and aspartic acids and their associated metabolites were isolated from brain, liver, and blood, and the isotope concentration in the various amino and amide groups was determined. The results support the conclusion that the metabolism of the dicarboxylic amino acid synthesized in the tissue and of its metabolic derivatives occur in cellular compartments. (Contractor's abstract)

2097

New York State Psychiatric Inst., N. Y.

CARBON DIOXIDE FIXATION IN LOBSTER NERVE, by S.-C. Cheng and H. Waelsch. [1962] [2]p. incl. table, refs. [AF 49(638)725] Unclassified

Published in Science, v. 136: 782-783, June 1, 1962.

Aspartic, glutamic, malic, and citric (isocitric) acids were isolated by chromatographic methods from lobster nerves incubated with Ringer's solution containing C^{14}-bicarbonate. All the compounds were labeled; the bulk of the radioactivity appeared in the aspartic acid. The findings suggest the operation in lobster nerves of the citric acid cycle including CO_2 fixation. (Contractor's abstract)

2098

New York State U. Dept. of Chemistry, Long Island Center, Oyster Bay, N. Y.

INFRARED SPECTRUM AND STRUCTURE OF GERMYL CYANIDE, by T. D. Goldfarb. [1962] [5]p. incl. diagrs. tables, refs. (AFOSR-2464) (AF AFOSR-61-11) AD 400073 Unclassified

Also published in Jour. Chem. Phys., v. 37: 642-646, Aug. 1, 1962.

The infrared spectra of GeH_3CN and GeD_3CN have been investigated in the 260-4000-cm^{-1} region with prism and grating spectrophotometers. The expected C_{3v} symmetry has been confirmed, and 7 of the 8 fundamental vibrational modes of each molecule have been assigned to observed bands of appropriate shape. The frequencies of the remaining skeletal bending fundamentals have been assumed to be one-half the frequency of their observed overtones. The rotational structures of 2 of the perpendicular bands of GeH_3CN have been resolved and Coriolis coefficients have been determined. The spectrum in the region of the CN stretching fundamental indicates that the molecule is the normal cyanide. No evidence was obtained for the presence of the isocyanide. This observation is compared with those obtained for the alkyl germyl cyano and silyl cyano compounds which have been interpreted as equilibrium mixtures of the normal and the isocyanides. (Contractor's abstract)

2099

New York U. [Dept. of Chemistry] N. Y.

A FUNDAMENTAL STUDY OF THE HYDRODYNAMIC

EQUATIONS FOR FREE-RADICAL FLAMES, by E. S. Campbell. Final rept. Jan. 1957 - Oct. 1962 [6]p. incl. refs. (AFOSR-4163) (AF 49(638)169) AD 288595 Unclassified

An investigation of the ozone oxygen flame is presented. This will be another link in the study of how flame properties, thickness, speed, heat release, specific enthalpy, mol-fraction and fractional mass-flow profiles, are affected by the kinetic scheme and will offer another test of the importance of assumptions introduced in more approximate flame theories. This system is particularly advantageous for 2 reasons: (1) it has possibly the simplest kinetics of any real flame; and (2) it has been studied experimentally over a wider range of the relative importance of the different elementary reactions by the simple expedient of varying the input (O_3/O_2).

2100

New York U. [Dept. of Chemistry] N. Y.

A THEORETICAL STUDY OF SOME PROPERTIES OF LAMINAR STEADY STATE FLAMES AS A FUNCTION OF PROPERTIES OF THEIR CHEMICAL COMPONENTS, by E. S. Campbell, F. J. Heinen, and L. M. Schalt. [1962] [9]p. incl. diagr. tables, refs. (AFOSR-64-0145) (AF 49(638)169) AD 432553 Unclassified

Also published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 72-80.

This paper combines results of 3 different types of studies in an attempt to begin developing a mathematical and physical understanding of (1) how certain flame properties depend upon the characteristics of the flame gases, and (2) the significance of some approximations which have been introduced into flame theories. The types of studies are: (a) the construction of the functional form of the general asymptotic solutions to the hydrodynamic equations for laminar steady state flames as a function of the distance; (b) construction of different methods of solving the equation systems; and (c) numerical studies of these equation for both hypothetical and real flames. Mechanisms for the most important numerical sources of the ideas presented are given. The essential aspects of a free radical for flame kinetics are assumed to be: (1) In the presence of a free radical, a chemical reaction can proceed with a comparatively low activation energy. (2) The formation of a free radical requires a comparatively high activation energy. (3) Radical recombination involves a comparatively low activation energy. Finally, certain problems encountered in numerical integrations and comparative usefulness of some procedures are considered. Specific attention is devoted to the sensitivity of the calculation to starting values. (Contractor's abstract, modified)

2101

New York U. Dept. of Chemistry, N. Y.

EXISTENCE OF A "WELL-DEFINED" ENERGY FOR AN IONIC CRYSTAL; JUSTIFICATION OF EWALD'S FORMULAE AND OF THEIR USE TO DEDUCE EQUATIONS FOR MULTIPOSE LATTICES, by E. S. Campbell. [1962] [12]p. incl. refs. (AFOSR-1880) (AF 49(638)969) Unclassified

Also published in Jour. Phys. Chem. Solids, v. 24: 197-208, Feb. 1963.

The Ewald calculation of the potential defined by an ionic lattice is shown to be justified under simple general conditions which are given for the existence of a "well-defined" specific energy for an ionic crystal. The significance of the Ewald calculation and of these conditions is clarified by a prior discussion of the connection between the specific energy for finite and infinite lattices. It is shown that the original argument given to justify the deduction of formulae for multipole lattices from Ewald's equations contains a logical error which led to misleading statements about the potential defined by a lattice of dipoles. Conditions for the validity of these formulae are given and proved. Advantages of these formulae are discussed.

2102

New York U. Dept. of Chemistry, N. Y.

VALIDITY OF RATE FACTORS IN FREE RADICAL AROMATIC SUBSTITUTION, by R. T. Morrison. J. Cazes and others. [1962] [2]p. incl. table, refs. (AFOSR-64-1533) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-64-519 and National Science Foundation) AD 446137 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 4152-4153, Nov. 5, 1962.

On the basis of certain isotope effects and the findings of products formed by dimerization and disproportionation of arylcyclohexadienyl radicals, the validity of rate factors derived from data on isomer distribution and substrate competition in free radical aromatic substitution has been questioned. It is shown that side reactions have no significant effect on isomer distribution and relative reactivities measured by product analysis, and that such data provide valid rate factors for free radical aromatic substitution.

2103

New York U. Dept. of Electrical Engineering, N. Y.

AN EXTENSION OF ASCOLI'S THEOREM AND ITS APPLICATIONS TO THE THEORY OF OPTIMAL CONTROL, by S. S. L. Chang. Jan. 1962, 80p. incl. diagrs. (Technical rept. no. 400-51) (AFOSR-1973) (AF 49-(638)586) AD 275989 Unclassified

Presented at meeting of the Amer. Math. Soc., Jan. 24, 1964.

Also published in Trans. Amer. Math. Soc., v. 115: 445-470, Mar. 1965.

Ascoli's theorem deals with continuous functions and states that the space of bounded, equi-continuous functions is compact. The present paper extends it to the measurable functions. Both the space of bounded equi-measurable functions, and its product with the space of bounded equi-continuous functions are compact. The above theorem is applied to 2 problems in the theory of optimal control: (1) To give an existence proof of optimal control among allowed control functions which are measurable and enter the system equations in a non-linear manner; and (2) To derive a necessary condition for optimal control in bounded phase space. The condition is different and simpler than the one derived previously by Gamkrelidze.

2104

New York U. Dept. of Electrical Engineering, N. Y.

CONTROL SYSTEMS, by S. S. L. Chang and J. Ragazzini. Final rept. Mar. 1962, 30p. (AFOSR-2855) (AF 49(638)586) AD 281761 Unclassified

As the theory of control systems develops, the trend is toward the understanding of increasingly sophisticated systems which do more than merely constrain 1 or more controlled variables to perform or react in a fixed prescribed manner. Various criteria of optimization must be sought to establish the design rationale of such control systems, and much of the work reported has been so directed. For instance, systems which perform in an optimum manner not just under 1 set of conditions and inputs or with 1 set of parameters fall in this class. These are systems with fixed controllers broadly "tuned" to cope with a variation of system parameters that may occur slowly in time in 1 system or in an ensemble or fixed systems to which they may be attached. For terminal control systems, investigations of optimum control using Pontryagin's maximum principle to establish control policy have been developed.

2105

New York U. Dept. of Electrical Engineering, N. Y.

ON THE DIGITAL COMPUTER CLASSIFICATION OF GEOMETRIC LINE PATTERNS, by H. Freeman. [1962] [13]p. incl. diagrs. (AFOSR-3281) (AF AFOSR-62-152) Unclassified

Presented at Nat'l. Electronics Conf., Chicago, Ill., Oct. 8-10, 1962.

Also published in Proc. Nat'l. Electronics Conf., v. 18: 312-324, 1962.

This paper is concerned with techniques for the systematic classification of planar geometric line patterns of arbitrary configuration. The techniques are based on a method of quantitizing and encoding which facilitates classification in a digital computer. Emphasis is placed on three transformations from which a variety of pattern properties can be derived. The transformations involve, in turn, the directional components of the pattern, the pattern's degree of asymmetry about a specified set of axes, and the curvature components contained in the pattern's contours. (Contractor's abstract)

2106

New York U. [Dept. of Electrical Engineering] N. Y.

ADAPTIVE INFORMATION PROCESSING, by S. S. L. Chang. [1962] [8]p. incl. diagrs. (AFOSR-3436) (AF AFOSR-62-321) Unclassified

Presented at Western Electronic Show and Convention, Los Angeles, Calif., Aug. 23-24, 1962.

Also published in WESCON Technical Papers, v. 6: (Part 4): Paper no. 16.1, p. 1-6.

This paper describes the underlying theory of a computer program for interpolation, integration, and differentiation of a function f(x) which is unknown except at sampling points. The program yields automatically the formula to be used so that the processed result is the most likely one among all possible ones. The expected error is also given. The program is based on statistical decision theory with the assumption that f(x) has a power spectrum which may or may not be known. In the special case that there is no error at sampling points and the power spectrum is bandlimited, the general formula for interpolation is reduced to a cardinal data hold, and the general expression for expected error is reduced to a statement of Shanon's sampling theorem.

2107

New York U. Dept. of Electrical Engineering, N. Y.

JUSTIFICATION AND LIMITATION OF A TWO-PARAMETER, TWO-ADJUSTMENT, SELF-ADAPTIVE SYSTEM, by H. J. Perlis. [1962] [23]p. incl. diagrs. refs. [Rept. no. P63 120] (AFOSR-64-2317) (AF AFOSR-62-321) AD 452323 Unclassified

Presented at Winter general meeting of the Inst. Elec. & Electron. Engineers, New York, N. Y., Jan. 27-Feb. 1, 1963.

Also published in IEEE Trans. on Appl. and Indus., v. 82: 220-229, July 1963.

Control systems incorporating a plant with 2 varying parameters were analyzed. For the specific systems studied, it was shown that given the known nominal plant and system transmittance a passive system can be designed which will reduce the effects of plant variations to any desired level. Merely considering the fact that a known plant has wide variations in its parameters is not sufficient to justify an active adaptive system. When the effect of measurement noise in the system output is also considered, it is seen that self-adaption could be justified on the basis of both low sensitivity to plant variations and low relative measurement noise response. Since

the accuracy of identification is a function of measurement time, there appears to be a fundamental limitation in this class of self-adaption. The measurement time for a particular adjustment accuracy required that the plant parameters should not vary faster than a certain rate. This allows for a crude estimation to be made of how slow a slowly-varying plant must be.

2108

New York U. [Dept. of Physics] N. Y.

[GAS DISCHARGE PHENOMENA], by B. Bederson. Final letter rept. Jan. 1, 1962, 2p. (AF 18(600)1701) Unclassified

The general aim of this project has been the development and application of microwave diagnostic methods to investigate fundamental atomic processes occurring in gaseous discharges. In particular an attempt was made to study the volume and surface recombination of atomic hydrogen in a discharge. To this end, a cavity spectrometer apparatus was developed. The results were not sufficiently reliable or reproducible to obtain recombination information. Modifications and redesign of the apparatus are in progress.

3109

New York U. [Dept. of Physics] N. Y.

[ATOMIC HYDROGEN RECOMBINATION STUDIES], by B. Bederson. Final rept. Nov. 21, 1962, 3p. (AFOSR-404); (AF 49(638)943) AD 289275 Unclassified

The development of microwave diagnostic techniques for measuring the concentration of hydrogen atoms in a discharge and the application of these methods to the study of the rate constants associated with volume and surface recombination is investigated. A microwave cavity spectrometer has been built, especially designed to detect the 1420 Mc/sec transition in atomic hydrogen corresponding essentially to the zero field hyperfine separation of the ground state. It has been designed so that line shape measurements may be obtained in both the absorption and dispersion modes. One can then relate these measurements to the concentration of atomic hydrogen within a test volume positioned in the cavity, thereby providing a means of measuring recombination rate constants. (Contractor's abstract)

2110

New York U. Inst. of Mathematical Sciences, N. Y.

THE DISCRIMINANT OF HILL'S EQUATION, by D. L. Jagerman. Nov. 1962, 43p. (Research rept. no. BR-39) (AFOSR-4606) (AF 49(638)229) AD 297220 Unclassified

Structure theorems for the discriminant, $\Delta(\omega^2)$, of Hill's differential equation are developed by means of interpolatory function theory (cardinal series representations). A method of solution of Hill's equation is developed yielding an asymptotic expansion of the discriminant for large $|\omega|$ with error term $0(|\omega|^{-9})$. Asymptotic expansions for the eigenvalues λ_n, λ'_n for large n are obtained with error terms $0(n^{-7})$. Relations between the occurrence of double zeros of the discriminant and the period of the coefficient function in Hill's differential equation are established. A discriminant-like function $D(\omega^2)$ is introduced and an interpolatory function-theoretic structure result is obtained. (Contractor's abstract)

2111

New York U. Inst. of Mathematical Sciences, N. Y.

[HYDROMAGNETIC TURBULENCE], by R. H. Kraichnan. Final rept. Mar. 1, 1958-Feb. 28, 1962. June 1962 [12]p. incl. refs. (AFOSR-2779) (AF 49(638)341) AD 289438 Unclassified

Research under this contract has been directed towards the theoretical study of fluids under conditions where their behavior must be described statistically. Two broad classes of problems are considered: (1) turbulence, a random macroscopic motion in which the fluid can be considered a continuous medium and (2) microscopic statistical mechanics, in which the fluid is treated as a system of very many interacting particles. These 2 subjects are unified by the fact that very similar mathematical methods may be used for both.

2112

New York U. Inst. of Mathematical Sciences, N. Y.

ON THE MALKUS THEORY OF TURBULENCE, by E. A. Spiegel. [1962] [28]p. incl. diagrs. refs. (AFOSR-J504) (AF 49(638)341) AD 406281 Unclassified

Also published in Colloq. Internationaux du Centre Nat'l. de la Recherche Scientifique; Mécanique de la Turbulence, Marseille (France) (Aug. 28-Sept. 2, 1961), Paris, CRNS, No. 108: 181-208, 1962.

The aim of the Malkus theory is to avoid explicit nonlinear calculations by appeal to an optimization principle which characterizes statistically steady turbulence. The principle of maximum dissipation is offered as the possibly correct one and is shown to be equivalent to maximum heat transport for thermal turbulence. The present discussion outlines Malkus' procedure for finding the state of maximum heat transport in a thermally convecting, turbulent fluid. The particular situation discussed is that of natural convection between 2 parallel, rigid, slippery, perfectly conducting plates. The fluctuating velocity and temperature fields are decomposed into the set of normal modes of the linearized equations. In terms of this representation the energetics of thermal turbulence is discussed qualitatively and the effects of nonlinearity are pointed out. With this discussion as background, Malkus' assumptions are introduced. These are: (1) The mean temperature gradient is nowhere positive; (2) A finite range of wavenumbers is effective in transporting heat; and (3) The highest vertical wavenumber contributing to the heat transport is marginally stable on the mean temperature profile. Physical

arguments are offered to justify each of these assumptions, but the best justification is in the presentation of results. The Malkus theory predicts the observed form of the temperature gradient just inside the boundary layer and the correct form of the heat transport law. The final impression is that the theory has much to recommend it and that it raises a number of interesting questions about turbulent flows.

2113

New York U. Inst. of Mathematical Sciences, N. Y.

TRIAL AND ERROR PREDICATES AND THE SOLUTION TO A PROBLEM OF MOSTOWSKI'S, by H. Putnam. June 8, 1961, 42p. (Rept. no. IMM-NYU 290) (AFOSR-817) (AF 49(638)777) Unclassified

It is proved that every consistent formula of quantification theory has a model in Mostowski's field of sets. (Contractor's abstract)

2114

New York U. Inst. of Mathematical Sciences, N. Y.

ENUMERATION WITHOUT REPETITION, by H. Putnam. June 8, 1961, 4p. (Rept. no. IMM-NYU-291) (AFOSR-818) (AF 49(638)777) Unclassified

An example is constructed of a recursively enumerable family of recursively enumerable sets which can not be recursively enumerated without repetitions. (Contractor's abstract)

2115

New York U. Inst. of Mathematical Sciences, N. Y.

MAGNETOHYDRODYNAMIC FLOW PAST A THIN AIRFOIL, by E. Cumberbatch, L. Sarason, and H. Weitzner. Mar. 15, 1962 [71]p. incl. diagrs. (AFOSR-2278) (AF 49(638)1006) AD 276239 Unclassified

Also published in AIAA Jour., v. 1: 679-690, Mar. 1963. (AFOSR-J537; AD 407873)

The steady flow of a perfectly conducting magnetohydrodynamic fluid past a thin non-conducting airfoil is studied in the model in which the fluid variables obey the Lundquist equations linearized about a constant unperturbed flow. Hyperliptic flows, in which hyperbolic and elliptic fields are superimposed, are considered. Results of Grad, McCune and Resler, and Sears and Resler are extended to the case of an arbitrarily inclined unperturbed field. The general solution contains 4 line singularities along the characteristics through the ends of the body, and has 2 arbitrary constants. By a generalized Kutta-Joukowski condition these constants are fixed so that 2 of the line singularities disappear. Specifically, it is required that the solution be locally square integrable. Behavior of the exponents of the singularities is investigated by numerical computation and, in limiting cases, analytically. The singular parts of some flows are investigated numerically. (Contractor's abstract)

2116

New York U. Inst. of Mathematical Sciences, N. Y.

MAGNETOHYDRODYNAMIC MACH CONES, by E. Cumberbatch. [1962] [4]p. incl. diagrs. (AFOSR-J536) (AF 49(638)1006) AD 407868 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 1476-1479, Dec. 1962.

Features of the surfaces of main disturbance created by a small object in steady motion through a conducting fluid are examined. These surfaces are found by drawing tangent cones from the object to the relevant wave-front diagrams. The outer wave cone (when present) is smooth, but the 2 inner cones have cross sections similar to the cusped figures of the inner wave-front diagram. It is conjectured that the disturbance may be concentrated along such line cusps. This has particular relevance in the application of known 2-dimensional results to 3-dimensional problems, say in the well-known techniques of aerodynamics. In MHD the omission of the large disturbance characteristics implicit in a 2-dimensional solution may invalidate its use in any practical 3-dimensional problem. (Contractor's abstract)

2117

New York U. Inst. of Mathematical Sciences, N. Y.

MAGNETOHYDRODYNAMIC FLOW PAST A THIN AIRFOIL, by E. Cumberbatch, L. Sarason, and H. Weitzner. [1962] [12]p. incl. diagrs. (AFOSR-J537) (AF 49(638)1006) AD 407873 Unclassified

Also published in AIAA Jour., v. 1: 679-690, Mar. 1963.

For abstract see item no. 2115, Vol. VI.

2118

New York U. Inst. of Mathematical Sciences, N. Y.

DISPERSION RELATIONS IN RAREFIED GAS DYNAMICS, by L. Sirovich. [1962, [11]p. incl. diagrs. tables, refs. (AFOSR-J538) (AF 49(638)1006) AD 414695 Unclassified

Also published in Phys. Fluids, v. 6: 10-20, Jan. 1963.

The 1-dimensional initial-value problem of a monatomic single component gas is considered. Using the linearized Boltzmann equation the dispersion relation is studied. In addition to the usual gas-dynamic sound waves, one finds an infinity of decaying propagating waves. The phenomenon exhibits itself as a sequence of epochs, the last state of which is hydrodynamic. With reference to the same problem, macroscopic equations such as Euler, Navier-Stokes, Burnett, moments

equations, etc., are considered. In addition, the recently considered kinetic models of Gross et al. are applied to the problem. These various formulations are critically analyzed and compared with each other and with the Boltzmann analysis. Lastly, several modifications are offered which remedy some of the shortcomings which appear in the approximate theories. (Contractor's abstract)

2119

New York U. Inst. of Mathematical Sciences, N. Y.

ASYMPTOTIC THEORY OF THE BOLTZMANN EQUATION. II, by H. Grad. [1962] [34]p. incl. diagrs. refs. (AFOSR-J1212) (AF 49(638)1006) AD 424250 Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl., v. 1: 26-59, 1963. (AFOSR-5312)

Some properties are derived of the Boltzmann equation which are needed for asymptotic theory but which also have their own intrinsic interest. Bounds and information regarding the spectrum of the collision operator are obtained as well as an existence theorem for the linear Boltzmann equation. (Contractor's abstract)

2120

New York U. Inst. of Mathematical Sciences, N. Y.

STEADY MAGNETOHYDRODYNAMIC FLOW PAST A NONCONDUCTING WEDGE, by C. K. Chu and Y. M. Lynn. [1962] [6]p. incl. diagrs. refs. (AFOSR-J1274) (AF 49(638)1006) AD 424348 Unclassified

Presented at Seventeenth annual meeting of the Amer. Rocket Soc., Los Angeles, Calif., Nov. 13-18, 1962.

Also published in AIAA Jour., v. 1: 1062-1067, May 1963.

The steady 2-dimensional magnetohydrodynamic flow of an infinitely conducting fluid past a nonconducting wedge with nonaligned flow and magnetic field is discussed. The flows considered are in the superfast or fully hyperbolic regime. The flows consist of several regions of uniformity connected by shocks and expansion waves. Because of the boundary condition on the magnetic field, the magnetic field must be the same in the regions above and below the wedge; thus the flows in these regions are coupled, unlike in the case of ordinary supersonic gas-dynamics. Only small wedge angles and weak waves (characteristics) are considered. The problem thus is linearized, and explicit solutions are obtained which are qualitatively similar to the nonlinear solutions. Some interesting and unexpected features arise, and they are discussed in detail. (Contractor's abstract)

2121

New York U. [Inst. of Mathematical Sciences] N. Y.

SOME OBSERVATIONS ON CONTINUUM MECHANICS WITH EMPHASIS ON ELASTICITY, by J. J. Stoker. [1962] [40]p. incl. diagrs. refs. (AFOSR-4358) (AF 49-(638)1049) Unclassified

Also published in Bull. Amer. Math. Soc., v. 68: 239-278, July 1962.

This lecture gives a brief outline of the following: (1) the general theory of the mechanics of continuous media; (2) the stability under compression of thin and thick elastic solids; (3) bodies of zero thickness, i.e. elastic surfaces; and (4) some observations of a general nature about mathematics in the United States.

2122

New York U. Inst. of Mathematical Sciences, N. Y.

A GENERALIZATION OF MIXING-LENGTH THEORY OF TURBULENT CONVECTION, by E. A. Spiegel. Dec. 1962, 10p. (AFOSR-J1601) (AF 49(638)1065) AD 427627 Unclassified

Also published in Astrophys. Jour., v. 138: 216-225, July 1, 1963.

The mixing-length theory as currently employed is valid only when the mixing length is sufficiently small. The present work attempts to remove this limitation by writing a heat-transfer integral for convecting fluid elements. There then follows an integrodifferential equation for the mean temperature in a convecting medium. It is indicated how this equation may be used to include the effects of penetration into convectively stable regions from adjacent stable regions.

Nobel Inst. for Neurophysiology, Stockholm (Sweden).
see Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

2123

Nobel Inst. for Physics, Stockholm (Sweden).

WIDE RANGE TIME TO PULSE HEIGHT CONVERTER, by P. Thieberger. Feb. 10, 1962 [15]p. incl. illus. diagrs. refs. (Technical note no. 9) (AFOSR-2244) (In cooperation with Royal Inst. of Tech., Stockholm (Sweden)) (AF 61(052)118) AD 272430 Unclassified

Also published in Arkiv Fysik, v. 22: 127-137, 1962.

A fast pulse sampling circuit used with the saw-tooth generator of a fast oscilloscope is described. The arrangement is intended for time measurements such as arising in nuclear half-life determinations or time of flight experiments. It is shown that it is useful for times ranging from 10^{-10} sec to about 100 sec. (Contractor's abstract)

2124

Nobel Inst. for Physics, Stockholm (Sweden).

DETERMINATION OF THE MAGNETIC MOMENT OF THE FIRST EXCITED STATE IN Sc^{44}, by I. Bergström and P. Thieberger. Apr. 15, 1962 [14]p. incl. diagrs. tables, refs. (Technical note no. 10) (AFOSR-2703) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)118 and Statens Rad för Atomforskning) AD 280977 Unclassified

Also published in Arkiv Fysik, v. 22: 307-315, 1962.

The g-factor of the 153 ns first excited state in Sc^{44} has been determined by studying the oscillations around the exponential decay curve which appear when the sample is placed in a magnetic field. With the assumption that paramagnetic effects can be neglected, a value for the g-factor of 0.35 ± 0.02 is obtained as an average of 3 different runs. From conventional angular correlation measurements an anisotropy of + 9.5 ± 2.5% is obtained. A_2 as calculated from the amplitude of the oscillations corresponds to an anisotropy of 6.5 ± 1%. This supports the assumption that the multipolarities involved are pure M1 and that the spin sequence is 1, 2 and 3 units, which corresponds to an anisotropy of 7.7%. The magnetic moment of the 153 ns state is then + 0.70 ± 0.04 nuclear magnetons. (Contractor's abstract)

2125

Nobel Inst. for Physics, Stockholm (Sweden).

INVESTIGATION OF NUCLEAR REACTIONS INDUCED BY HEAVY ION BOMBARDMENT AND OF EXCITED LEVELS IN HEAVY NUCLEI, by L. Bergström and B. Astrom. June 15, 1962 [18]p. incl. diagrs. refs. (AFOSR-2975) (AF 61(052)118) AD 278240 Unclassified

The following work is reported: (1) Angular correlations in (α, p)- and (α, α')- reactions at 14 mev. (2) Heavy ion induced reactions and properties of light astatine isotopes formed in those reactions. (3) Study of energy levels, transition probabilities, etc. in several isotopes mostly in the lead region, excited in radioactive decay. (4) Stopping of heavy ions in various materials, and (5) New instruments and methods - (a) automatic gain controlled amplifier, (b) use of CRT oscilloscopes in time- and pulse-height measurements, (c) time to pulse-height converter, and (d) surface barrier semiconductor detectors. (Contractor's abstract)

2126

[Nobel Inst. for Physics, Stockholm (Sweden)]

INVESTIGATIONS OF GAMMA RADIATION FROM NUCLEAR REACTIONS, by K. G. Malmfors. Final rept. Feb. 1, 1961 - Jan. 31, 1962, July 3, 1962, 3p. (AFOSR-3161) (AF EOAR-61-8) Unclassified

In these investigations, the proton beam from the cyclotron was directed to a target which was placed inside the spectrometer at the distance of 5 cm from a gold converter. The flight-times of the electron and the positron were converted into pulse-height and added together, thus making it possible to display a γ-spectrum on a 100-channel pulse-height-analyzer. A systematic study was carried out on the influence of the size, shape, and thickness of the converter in order to find the optimum conditions. The results indicate that the width of the converter should not be more than 2 or 3 mm so that the electrons and the positrons get free of the converter after the first revolution. An investigation was made of the possibility of placing the target material on the converter and to lead the cyclotron beam up to this new target position. An investigation of the possible use of the spectrometer as a Compton-spectrometer without depending on the cyclotron for the timing system was made.

2127

Nobel Inst. for Physics, Stockholm (Sweden).

MASS NUMBER ASSIGNMENTS AND γ-RAY SPECTRA OF SOME NEUTRON RICH Sn AND Sb ISOTOPES, by J. Ahler, G. H. Neumann and others. [1961] [14]p. incl. diagrs. tables, refs. [AF EOAR-62-86] Unclassified

Published in Arkiv Fysik, v. 21: 35-48, 1961.

Electromagnetic isotope separations have been performed on Sn and Sb, prepared from fissioned uranium. The different samples were studied for their half-lives and γ-spectra. New information was obtained concerning γ-rays. Data are given for Sn^{127}, Sn^{128}, Sb^{127}, Sb^{128} and Sb^{129}. The results obtained are mainly in agreement with previously known data.

2128

North American Aviation, Inc. Missile Development Div., Downey, Calif.

BOUNDARY LAYER TRANSITION AT SUPERSONIC SPEEDS-THREE DIMENSIONAL ROUGHNESS EFFECTS (SPHERES), by E. R. van Driest and C. B. Blumer. Aug. 15, 1961, 48p. incl. diagrs. tables. (Rept. no. SID-61-275) (AFOSR-1531) (AF 49(638)250) AD 265237 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 909-916, Aug. 1962.

For abstract see item no. 2025, Vol. V.

2129

North American Aviation, Inc. [Missile Development Div.] Downey, Calif.

THE EFFECTS OF FREE-STREAM TURBULENCE AND PRESSURE GRADIENT ON BOUNDARY LAYER TRANSITION, by E. R. van Driest and C. B. Blumer. May 1962, 13p. incl. diagrs. (Rept. no. SID-62-657) (AFOSR-3146) (AF 49(638)250) Unclassified

A theory of boundary layer transition is presented which includes the effects of free-stream turbulence and pressure gradient. The basic notion underlying the development concerns the separation of the vorticity in the boundary layer. The theory agrees well with experimental data. It can also indicate the effects of Mach number and heat transfer.

2130

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

THE ONSET OF DETONATION IN A DROPLET COMBUSTION FIELD, by F. B. Cramer. [1962] [5]p. incl. illus. diagrs. table. [AF 49(638)817] Unclassified

Published in Ninth Symposium (Internat'l.) on Combustion, Cornell U., Ithaca, N. Y. (Aug. 27-Sept. 1, 1962), New York, Academic Press, 1963, p. 482-487.

A sequence of events has been described which offers an explanation for the processes leading to the onset of detonation in a heterogeneous field of low volatility fuel droplets. While the gross pattern appears superficially similar to that occurring in premixed gases, the detailed mechanisms must be explained in terms of the physical behavior of the liquid component of the 2-phase system. The pressure ratios and shock velocity of both weak and strong shocks fall very close to the values which are calculated for oxygen. The highest concentration of fuel was 0.20 vol-%. The transport phenomena to produce fuel vapor at a rate sufficient to drive these detonation-like waves at the temperature differentials involved require specific surfaces which are orders of magnitude greater than the original spray presented. A type of mechanitical shattering must be available which will produce enough of a less than 10μ droplet mist to provide sufficient fuel vapor to continue to drive the detonation front. The effects of the predetonation, flame-driven flow field controls the time and magnitude of the onset of detonation through droplet shattering these flows impose. (Contractor's abstract, modified)

2131

North American Aviation, Inc. Space and Information Systems Div., Downey, Calif.

BOUNDARY LAYER TRANSITION: FREESTREAM TURBULENCE AND PRESSURE GRADIENT EFFECTS, by E. R. van Driest and C. B. Blumer. [1962] [4]p. incl. diagrs. table, refs. (AFOSR-J1036) (AF 49-(638)1178) Unclassified

Also published in AIAA Jour., v. 1: 1303-1306, June 1963.

A theory of boundary layer transition is presented which includes the effects of freestream turbulence and pressure gradient. The basic notion underlying the development concerns the remoteness of the boundary layer vorticity from the surface. The theory agrees well with experimental data. The laminar boundary layer solutions of Pohlhausen and Falkner-Skan are used to calculate the effect of pressure gradient on transition. Engineering formulas are presented, and one example is calculated showing the application of the theory to a body of revolution. The theory also can indicate the effects of Mach number and heat transfer.

2132

North American Philips Co., Inc. Philips Labs., Irvington-on-Hudson, N. Y.

RESEARCH ON X-RAY DETERMINATION OF PRECISION LATTICE PARAMETERS, by W. Parrish, M. Mack, and J. Taylor. Final rept. June 30, 1962, 57p. incl. illus. diagrs. tables, refs. (Technical rept. no. 156) (AFOSR-3082) (AF 49(638)620) Unclassified

The application of the centroid method to powder line profiles obtained with the x-ray diffractometer is shown to lead to lattice parameters which are independent of the diffraction angle. Thus it appears that the lattice parameter is free of systematic errors and that the centroid method has properly accounted for the aberrations which distort and shift the line profile. The instrumentation and methodology necessary for results of the highest precision are discussed. The effect of interferences from the $K\alpha_{3,4}$ satellites and Kβ lines is described. Three different methods that have been proposed for the determination of centroids have been investigated and applied to both spectral and powder line profiles, and the necessity for equivalence between the centroids of the spectral profile and the line profile is discussed. The line shapes and the centroids of observed and analytic spectral profiles are compared for both CuKα and FeKα radiations. Preliminary centroid results for the lattice parameter of tungsten (at 25°C and corrected for refraction) are: $\underline{a}_o$ = 3.16552 A with CuKα, and 3.16544 A with FeKα. Although peak angles are not amenable to correction for aberrations, various peak measurements have been made. The lattice parameter of tungsten (at 25°C and corrected for refraction) derived from peak angles corresponding to maximum $K\alpha_1$ intensity is: $\underline{a}_o$ = 3.16517 A with $CuK\alpha_1$, and 3.16521 A with $FeK\alpha_1$. A list of proposed publications, in which the topics treated in this report will be covered in greater detail, is included.

2133

North Carolina State Coll. Dept. of Mathematics, Raleigh.

AN EXTERNAL CRACK PROBLEM - SYMMETRICAL CASE, by M. Lowengrub. Sept. 5, 1962, 18p. incl. diagrs. tables. (AFOSR-3671) (AF 49(638)1159) AD 283801 Unclassified

The problem of determining the stress field in the neighborhood of a crack given externally in an infinite elastic solid which is symmetrically deformed is discussed. The particular problem where the crack is deformed by applying an axially symmetric pressure which may be considered as varying along the length of the crack is discussed. This problem is then reduced to a mixed boundary value problem. It is assumed that the

equations of the classical (infinitesimal) theory of elasticity hold. The expressions for the stress and displacement components are discussed and the corresponding value problem is considered. The forms of the solution in certain special cases are derived and the components of stress and displacement for some of these special cases are tabulated. (Contractor's abstract)

2134

North Carolina U. [Dept. of Chemistry] Chapel Hill.

A KINETIC STUDY OF THE EXCHANGE OF COPPER ION BETWEEN 1-(2-HYDROXY-1-NAPTHYLAZO)-2-NAPTHOL-4 SULFONIC ACID AND (ETHYLENEDINITRILO) TETRAACETIC ACID, by D. W. Rogers and C. N. Reilley. July 20, 1960 [20]p. incl. diagrs. tables. (Rept. no. UNC-Chem-CNR no. 6) (AFOSR-TN-60-822) (AF 49(638)333) Unclassified

The transfer of copper ion from its 1-(2 hydroxy-1-napthylazo)-2-napthol-4-sulfonic acid (Z) complex to EDTA (Y) is described by the equation Rate = $18[CuZ^-][H^+] + 32[CuZ^-][H_2Y^{-2}] + 100[CuZ^-][HY^{-3}] + 70[CuOHZ^{-2}][HY^{-3}]$ between pH 3 and 12. The rate equation of the back reaction is Rate = $1.7[CuHY][H_2Z^-] + 0.63[CuY^{-2}][H_2Z^-] + 56[CuY^{-2}][HZ^{-2}] + 1000[CuOHY^{-3}][HZ^{-2}]$. Each term in the rate equation represents a reaction path through different protonated or hydroxylated reactant forms. A mathematical technique is given for the separation of simultaneous reaction paths in complex systems. The law of Guldberg and Waage is followed to a fair approximation from which speculations are made on the structure of the activated complex. The rates of 6 similar reactions have been studied at one pH and are discussed in relation to the proposed mechanism. (Contractor's abstract)

2135

North Carolina U. [Dept. of Chemistry] Chapel Hill.

STUDIES IN THE CHEMISTRY OF METAL CHELONATES, by C. N. Reilley. Final rept. Nov. 20, 1962, 10p. incl. refs. (AFOSR-4312) (AF 49(638)333) AD 601732 Unclassified

Important progress has been made toward understanding the mechanism of metal-chelonate reactions in electrochemistry, solution processes of importance to analytical chemistry, and biological systems. Much of the effort was devoted to fundamental studies of metal chelonate reactions. While such effort was expended in large measure on specific systems, a number of general conclusions of broad applicability were found. An annotated bibliography of the 17 published reports generated by the researches is listed.

2136

North Carolina U. Dept. of Chemistry, Chapel Hill.

CATALYTIC POLAROGRAPHIC CURRENT OF CERTAIN NICKEL (II) COMPLEXES. APPLICATION TO THE ANALYSIS OF CERTAIN ORGANIC COMPOUNDS CONTAINING BASIC NITROGEN, by H. B. Mark, Jr. and C. N. Reilley. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-64-1398) (AF 49(638)333) AD 444450 Unclassified

Presented at Combined meeting of the Southeast and Southwest Sections of the Amer. Chem. Soc., New Orleans, La., Dec. 7-9, 1961.

Also published in Anal. Chem., v. 35: 195-199, Feb. 1963.

The catalytic current observed as a prewave when nickel ion is reduced polaragraphically in the presence of a small quantity of pyridine is applicable for the analysis of pyridine. The effect of temperature, pH and concentrations of reactants are investigated. The optimum concentration range for the analysis of pyridine is 1×10^{-5} to 3×10^{-4} M. Several other pyridine and amino compounds exhibit catalytic prewaves in the presence of nickel ion and can be determined by this method. (Contractor's abstract)

2137

North Carolina U. Dept. of Chemistry, Chapel Hill.

RAPID CHELOMETRIC DETERMINATION OF CHROMATE AS Cr(III)-EDTA BY REDUCTION IN THE PRESENCE OF EDTA, by D. A. Aikens and C. N. Reilley. [1962] [3]p. incl. diagr. tables. (AFOSR-64-1399) (AF 49(638)333) AD 444449 Unclassified

Also published in Anal. Chem., v. 34: 1707-1709, Dec. 1962.

Reduction of Cr(VI) in the presence of a slight excess of EDTA leads to quantitative formation of Cr(III)-EDTA and provides a simple, rapid method for the chelometric determination of milligram amounts of chromate. The key to this method is chelation of labile intermediate Cr(V) and/or Cr(IV) oxidation states by EDTA, followed by further reduction to substitution inert Cr(III)-EDTA. The time required for a single determination is 5 to 6 min. The relative standard deviation is 1.4% with 0.5 mg. of Cr and 0.8% with 5.0 mg of Cr. The effects of pH, reducing agent, and buffer composition are discussed. Recovery of Cr is complete with 0.12M triethanolamine buffer, pH 6.1 to 6.9, and $NaHSO_3$ as the reducing agent. Excess EDTA is back-titrated at pH 2.5 to 3.5 with Th. (Contractor's abstract)

2138

North Carolina U [Dept. of Mathematics] Chapel Hill.

ON THE THEOREMS OF PERRON AND FROBENIUS

ON NON-NEGATIVE MATRICES, by A. Brauer. [1962] [8]p. incl. refs. (AFOSR-J186) [AF 18(603)-38] AD 400177 Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szegö, C. Loewner and others. Stanford U. Press, 1962, p. 48-55. (Title varies)

For abstract see item no. 2039, Vol. V.

2139

[North Carolina U. Dept. of Physics, Chapel Hill]

[GRAVITATION AND FIELD THEORY], by B. S. DeWitt. Final rept. Dec. 1, 1960-May 31, 1961. June 1, 1961, 6p. (AFOSR-1430) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)563 and Office of Naval Research) Unclassified

By studying the basic properties of the gravitational field and its relationship to quantum mechanics, it was hoped that equations predicting new and interesting experiments could be performed and that new effects, such as the concept of gravitational radiation, might be observed. The attack used was the method of canonical quantizing the gravitational field which has succeeded in other cases where there is a classical analog. The next phase will be to investigate the true observables and their relation to the constraints of the systems.

2140

North Carolina U. [Dept. of Physics] Chapel Hill.

POINT DEFECTS AND DISLOCATIONS IN SILVER CHLORIDE, by M. N. Kabler, H. Layer and others. [1962] [12]p. incl. diagrs. refs. (AFOSR-2664) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)865, Army Research Office (Durham), and Atomic Energy Commission) AD 276839 Unclassified

Three experiments on imperfections in AgCl crystals are reviewed. Studies of the strain-aging in impure crystals as a function of time, temperature, and purity establish that the dislocations are pinned by divalent impurities which migrate with an activation energy of 0.46 ev. Observations of ionic conductivity during pulsed plasticity indicate that excess Ag interstitials are created with an efficiency of 10^{-7} fractional concentration per unit strain; these interstitials have a lifetime of 10^{8} jumps. Measurements of the annealing out of excess electrical conductivity of quenched crystals give the divacancy binding energy to be 0.42 ev and the migration energy to be 1.0 ev. The concentration of Schottky defects at high temperatures is estimated to be approximately 0.1%. (Contractor's abstract)

2141

North Carolina U. Dept. of Physics, Chapel Hill.

DELINEATION OF TRACKS OF HEAVY COSMIC RAYS AND NUCLEAR PROCESSES, WITHIN LARGE CRYSTALS OF SILVER CHLORIDE, by C. B. Childs and L. M. Slifkin. July 1962 [19]p. incl. illus. refs. (AFOSR-3030) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)865 and Army Research Office (Durham)) AD 278672 Unclassified

Also published in Rev. Scient. Instr., v. 34: 101-104, Jan. 1963.

Tracks of energetic charged particles, such as heavy primary cosmic rays and the products of nuclear collisions, have been made visible within the interior of large, transparent crystals of AgCl. The tracks are delineated by photoelectric formation of metallic Ag along them. This technique may be useful as a convenient and distortion-free method for the study of heavy primaries and fission fragments.

2142

North Carolina U. [Dept. of Physics] Chapel Hill.

A NEW TECHNIQUE FOR RECORDING HEAVY PRIMARY COSMIC RADIATION AND NUCLEAR PROCESSES IN SILVER CHLORIDE SINGLE CRYSTALS, by C. B. Childs and L. M. Slifkin. [1962] [2]p. incl. illus. (AFOSR-3364) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)865 and Army Research Office (Durham)) Unclassified

Presented at Eighth Scintillation Counter Symposium, Washington, D. C., Mar. 1-3, 1962.

Also published in I. R. E. Trans. on Nuclear Sci., v. NS-9: 413-414, June 1962.

A new technique for recording heavy primary cosmic radiation and nuclear processes has been developed through decoration of dislocations formed by these processes in large AgCl single crystals. The crystals are prepared and exposed to cosmic radiation during high altitude balloon flights. The crystals are then treated according to the Haynes-Shockley photoelectric technique which results in Ag collecting at the dislocations thereby decorates the dislocations at room temperature within 2 hr. Since AgCl is transparent to visible light, the decorated dislocations are observable with an optical microscope at a magnification of about 150-200. A one-to-one correspondence has been established between tracks in the crystals and those in photographic emulsions accompanying the crystals during balloon flights. Examples of heavy primary cosmic radiation and nuclear processes in crystals are shown. (Contractor's abstract)

2143

North Carolina U. [Dept. of Physics] Chapel Hill.

DISLOCATION-IMPURITY INTERACTIONS AND STRAIN

AGING IN AgCl, by M. N. Kabler, M. G. Miller, and L. M. Slifkin. [1962] [5]p. incl. diagrs. refs. (AFOSR-4472) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)865 and Army Research Office (Durham)) AD 291837 Unclassified

Also published in Jour. Appl. Phys., v. 34: 1953-1957, July 1963.

Strain aging in AgCl single crystals containing a few parts in 10^5 polyvalent metal impurity has been studied over the temperature range -12° to 51°C. At room temperature, the aging process requires of the order of half an hour to go to completion. The measured activation energy for the aging rate is 0.46 ± 0.06 ev. The maximum stress increment due to aging decreases with increasing temperature with an effective activation energy of 0.1 ev. On the basis of the kinetics of the process, it is demonstrated that the dislocation pinning giving rise to strain aging is due to the migration to the dislocations of the impurity ions themselves rather than the vacancies they introduce. Sharp upper yield points have been observed; they are discussed in terms of current concepts of dislocation multiplication and unpinning. (Contractor's abstract)

2144

North Carolina U. Dept. of Physics, Chapel Hill.

DETECTION OF NUCLEAR DISINTEGRATIONS PRODUCED BY 1.55-BEV PROTONS IN SILVER CHLORIDE SINGLE CRYSTALS, by C. B. Childs and L. [M.] Slifkin. [1962] [2]p. incl. diagrs. (AFOSR-J159) (AF 49(638)865) AD 400066 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 354-355, Oct. 15, 1962.

A method was described by making the tracks of primary cosmic-ray particles visible in transparent crystals of AgCl. Application of the technique to the study of nuclear reactions produced by 1.55 bev protons from the Brookhaven cosmotron is now described. After exposure in the beam, each crystal is developed by subjecting it to a synchronous pulsed electric field and ultra-violet light. Photoelectrons swept into the interior of the crystal are trapped at the imperfections along the particle tracks. These electrons trap interstitial Ag ions, producing metallic Ag, thus rendering the tracks visible.

2145

North Carolina U. [Dept. of Physics] Chapel Hill.

GIANT DISLOCATION LOOPS IN SILVER CHLORIDE CRYSTALS (Abstract), by A. Fukai and L. [M.] Slifkin. [1962] [1]p. [AF 49(638)865] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 210, Mar. 26, 1962.

Large, diamond-shaped dislocation loops, concentric about small included particles, in AgCl crystals were discovered by C. Childs (to be published). Further studies are presented here. The crystal was annealed at 445°-450°C for 44 hr in quartz powder, cooled to room temperature at 5°/hr, and the dislocations decorated by sweeping photoelectrons through the specimen. The large, 4-sided loops thus found have an average size of 120 μ on the side, and range from 14 to 310 μ. Three configurations have been observed: (1) multiple, diamond-shaped loops, coplanar and concentric, with an inclusion in the center; this corresponds to Childs' earlier findings; (2) isolated diamonds with no precipitates inside; (3) large (about 100 μ diam) polygonal helices. These loops are not found within a few hundred microns of the surface, and have been seen only in crystals of low-dislocation content (this crystal had fewer than 10^4 lines/cm^2). They presumably form during cooling by climb (as suggested by R. Thomson and J. Mitchell), thus explaining their absence near the surface and in material of high-dislocation content. The fractional-vacancy concentration required to account for the loops is only 10^{-9}.

2146

North Carolina U. [Dept. of Physics] Chapel Hill.

SELF-DIFFUSION IN SILVER-GOLD SOLID SOLUTIONS (Abstract), by A. Gardner and L. [M.] Slifkin. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)865] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 234, Mar. 26, 1962.

Earlier data of W. Mallard and R. Bass on self-diffusion of silver tracer (Ag^*) and gold tracer (Au^*) in single crystals of silver-gold solutions have been extended and completed. The 114 diffusion coefficients thus obtained determine D_0 and Q (from the Arrhenius equation) for 9 compositions from pure Ag to pure Au. Some interesting results and deductions are: (1) correlation factors calculated from Lidiard's theory are of reasonable magnitude; (2) addition of the fast-diffuser Ag to the slow-diffuser Au reduces the D's for both tracers, in contrast to predictions of theories based on local kinetics; (3) for both tracers, D_0 decreases exponentially by a factor of 8 from pure Ag to pure Au; (4) this dependence of D_0 indicates that entropy of migration of a vacancy decreases by 2R from pure Ag to pure Au; (5) at a given composition, D_0 is larger for Au^* than Ag^* by about 40%; this can be accounted for semiquantitively; (6) the decreases in the Q's for both tracers with increasing Au content consist of comparable contributions from decreases in vacancy-migration energies and formation energies; and (7) at low temperatures, the measured D's are almost invariably higher than expected, even though the penetration plots are normal.

2147

North Carolina U. Dept. of Physics, Chapel Hill.

QUANTIZATION OF FIELDS WITH INFINITE-DIMENSIONAL GROUPS. III. GENERALIZED SCHWINGER-FEYNMAN THEORY, by B. S. DeWitt. May 1962 [65]p. incl. diagrs. refs. (Publication no. 13) (AFOSR-2572) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-72 and Office of Naval Research) AD 275778 Unclassified

Also published in Jour. Math. Phys., v. 3: 1073-1093, Nov.-Dec. 1962.

Nonlinear field theories having elementary vertex functions of arbitrarily high order are presented. Emphasis is given to purely formal aspects of the theory which may be expected to survive generalization to situations in which standard asymptotic conditions are inapplicable. Since the context in which the field nonlinearities are assumed to appear is that of a non-Abelian infinite dimensional invariance group, detailed attention is given to the question of a group invariant measure for the Feynman functional integral. It is shown that the physically important part of the measure is not determined by the group. The theory of the propagators and correlation functions are also given which characterize the system when invariant variables are introduced. The existence of a c-number action functional which contains a complete description of all quantum processes is proved. The second variational derivatives of this functional constitute the wave operator for the 1-particle propagators (including all radiative corrections) and its higher derivatives are the renormalized vertex functions. Finally, the implications for application to quantum gravidynamics are discussed. Because it leads to nonlocal covariant equations for a complex metric tensor the way is open to transmutations of topology at the quantum level. (Contractor's abstract, modified)

2148

North Carolina U. Dept. of Physics, Chapel Hill.

QUANTIZATION OF FIELDS WITH INFINITE-DIMENSIONAL GROUPS. III. GENERALIZED SCHWINGER-FEYNMAN THEORY, by B. S DeWitt. [1962] [21]p. incl. diagrs. refs. (AFOSR-J227) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-72 and Office of Naval Research) AD 400855 Unclassified

Also published in Jour. Math. Phys., v. 3: 1073-1093, Nov.-Dec. 1962.

For abstract see item no. 2147, Vol. VI.

2149

North Carolina U. [Dept. of Physics] Chapel Hill.

ON THE ROLE OF GRAVITATIONAL FIELDS IN SOME ELEMENTARY PARTICLE PROCESSES, by L. Halpern. [1962] [31]p. incl. diagrs. refs. (AFOSR-J330) (AF AFOSR-61-72) AD 408007 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 1239-1269, Sept. 16, 1962.

With the aid of a suitable perturbation formalism, the effect of an external gravitational field on elementary particle processes is investigated. Electromagnetic bremsstrahlung by charged scalar particle waves is treated and the dependence of the result on the inserted data and their empirical limits is analyzed. Application of the results to gravitational bremsstrahlung by particles of vanishing rest-mass is made. On the basis of these results, gravitational radiation from elementary particle processes is shown to be negligible. Some quantum electrodynamic processes of higher order, with closed loop diagrams are treated in curved space and the removal of their infinites by renormalization is discussed. Part of the matrix element for the process of photon trisection into 3 photons, has been evaluated and an upper limit for the cross-section of this process has been obtained in first order approximation in the external gravitational field. The magnitude of certain contributions from higher order terms has been estimated, but complete conclusions have not yet been obtained. A number of other processes, involving particles with spin and their radiative corrections are treated or discussed. Among the cross-sections of these processes, in first order perturbation only that for the trisection of photons becomes significant at the empirical energy limit: these theoretical results at present deny experimental possibilities. The role of terms of higher order is not yet known. Experimental possibilities for obtaining improved knowledge of the empirical upper limit of the energy losses produced on photons are suggested. General empirical aspects of the theoretical results are discussed. The Appendix contains an auxiliary theorem on a relation between the second derivatives of the metric tensor and the Riemann-Christoffel tensor at points, where geodesic co-ordinates are introduced.

2150

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. (In cooperation with Case Inst. of Tech., Cleveland, Ohio) (Computing Center publ. no. 1022) (AFOSR-J441) (AF 49(638)213) AD 408295 Unclassified

Also published in Bull. Inst. Internat'l. Stat., v. 38: 257-271, 1961.

For abstract see item no. 1863, Vol. IV.

2151

North Carolina U. Inst. of Statistics, Chapel Hill.

RESOLVABLE INCOMPLETE BLOCK DESIGNS WITH

TWO REPLICATIONS, by R. C. Bose and K. R. Nair. [1962] [16]p. incl. tables. (AFOSR-J450) (AF 49(638)-213) AD 407899 Unclassified

Also published in Sankyā Indian Jour. Stat., v. 24, Series A: 9-24, Feb. 1962.

A class of resolvable incomplete block designs with 2 replications is given here. This includes the 2 known replicate designs, which are either the sample square or rectangular lattices and their extensions. The designs in this class are not necessarily PBIB designs but their duals are PBIB designs with 3 associate classes. Nevertheless the treatments in these designs have an association scheme with a maximum of 7 associate classes. A list of all the designs with $k \leq 10$ belonging to this class has been prepared and methods of construction of designs explained. The necessary formulae for analysis with recovery of interblock information are derived. (Contractor's abstract)

2152

North Carolina U. [Inst. of Statistics] Chapel Hill.

RESPONSE MODEL COEFFICIENTS AND THE INDIVIDUAL DEGREES OF FREEDOM OF A FACTORIAL DESIGN, by R. C. Bose and R. L. Carter. [1962] [12]p. (AFOSR-J474) (AF 49(638)213) AD 408214 Unclassified

Also published in Biometrics, v. 18: 160-171, June 1962.

A model is presented which gives the response corresponding to any point in the factor space (not necessarily a sample point) in terms of component-functions which, in turn, depend only on the experimental levels employed. Examples are included, showing how this response may be expressed as a linear combination of the conventional effects and interactions; this representation permits interpolation along the response surface, using these effects and interactions as coefficients. Finally, it is shown that, in the general multifactor case, the transformation between the conventional effects (normalized by constant multipliers) and the responses at the sample points is the Kronecker product of matrices whose elements are component-functions for the individual factors.

2153

North Carolina U. [Inst. of Statistics] Chapel Hill.

BALANCED BLOCK DESIGNS WITH TWO DIFFERENT NUMBERS OF REPLICATES, by L. C. A. Corsten. [1962] [21]p. (AFOSR-J624) (AF 49(638)213) AD 414099 Unclassified

Also published in Biometrics, v. 18: 499-519, Dec. 1962.

This paper attempts a systematic attack on the problem of construction of incomplete block designs having unequally replicated treatments, but otherwise balanced in the sense that the accuracy of the comparison between any pair of treatments depends only on the number of replicates of the treatments, and not on the choice of the particular pair of treatments from the set of all similarly replicated pairs. A further advantage of balance is the relatively simple form of analysis, but this aspect is of secondary importance, since general methods are available for the analysis of incomplete block designs. Only those designs are considered in which each treatment is replicated either r_1 or r_2 times, with $r_1 < r_2$; treatments will be called rare and frequent treatments. Then all comparisons between 2 rare treatments will be of equal accuracy, as will be all comparisons between 2 frequent treatments, and all comparisons between a rare and a frequent treatment. However, the 3 types of comparison will generally not be of equal accuracy.

2154

North Carolina U. [Inst. of Statistics] Chapel Hill.

THE EQUATION $a^M = b^N c^P$ IN A FREE GROUP, by R. C. Lyndon and M. P. Schutzenberger. [1962] [10]p. (AF 49(638)213) Unclassified

Published in Michigan Math. Jour., v. 9: 289-298, Dec. 1962.

The question of finding all solutions for the equation $a^M = b^N c^P$ in a free group is of interest only if none of the exponents is 0 or 1; it is assumed that M, N, $P \geq 2$. The equation possesses obvious solutions for which a, b, and c are all powers of a common element; it is shown here that these are all solutions. Some properties of the free monoid F of words representing elements in a free group are discussed. In section 3, the problem of finding all the solutions of the equations $a^M = b^N c^P$ in G is reduced to that of finding all solutions of each of 2 equations in F. It is shown in turn that each of these equations has only the obvious solutions. The greater part of the argument deals with the case that one of the exponents is 2 or 3. This suggests that arbitrary equations in powers of elements from a free group have only more or less obvious solutions when the exponents are sufficiently large. More generally, one may expect that in some sense more complicated equations have fewer solutions, with only rather special equations possessing genuinely nondegenerate solutions. Thus the equation $a^M = b^N c^P d^Q$, which possesses a wealth of nontrivial solutions when all 4 exponents are 2, appears to have only obvious solutions when all exponents are large.

2155

North Carolina U. Inst. of Statistics, Chapel Hill.

FINITE COUNTING AUTOMATA, by M. P. Schutzenberger. [1962] [17]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)213 and Commonwealth Fund) Unclassified

Published in Inform. and Control, v. 5: 91-107, June 1962.

A family R_* of sets of words which is a generalization

of the family of regular sets is defined. The treatment is entirely algebraic and can be considered as an attempt towards a classification of the infinite monoids of finite-dimensional rational matrices which are the semidirect sum of finite monoids. If F is the set of input words, a finite counting automaton β of order q is the integral-valued function of F that is given by (1) a finite set of $(q_j + 1)$-tuples $(\alpha_j) = (F'_{j,1} F'_{j,2}, \ldots, F'_{j,q_j+1})$ of regular events $F'_{j,i}$ $(1 \leq j \leq M_j; q_1, \ldots, q_M \leq q)$, (2) a polynomial $\bar{\beta}$ with integral coefficients in the variates $\alpha_1, \ldots, \alpha_M$; for each $f \in F$, βf is defined as $\bar{\beta}(\alpha_1 f, \alpha_2 f, \ldots, \alpha_M f)$ where $\alpha_j f$ denotes the number of factorizations $f = f_1 f_2 \ldots f_{q_j+1}$ of f into $q_j + 1$ words such that $f_i \in F'_{j,i}$ $(1 \leq i \leq q_j + 1)$. The support of β is the set $\{f \in F: \beta f \neq 0\}$ and R_β is the family of supports of all such β. β is said to be linear if $\bar{\beta}$ is linear. Let $\overline{\deg}\ \beta = q'$ if q' is the least integer such that for all non-empty words f, $|\beta f|$ is bounded by a constant multiple of the q'th power of the length of f. The main result is that $\overline{\deg}\ \beta$ is the greatest lower bound of the numbers $r \geq 0$ such that $\lim \sup_{|f| \to \infty} |f|^{-r} |\beta f| = 0$; also that there is a linear finite counting automaton identically equal to β whose order is precisely $\overline{\deg}\ \beta$. It is proved that the family R_β is closed under union, intersection and product, but is not closed under the star operation as is the family of regular sets. (Math. Rev. abstract)

2156

Northeastern U. [Dept. of Physics] Boston, Mass.

LORENTZ INVARIANT PROPAGATION OF EM WAVES IN A PLASMA WITH DENSITY GRADIENT, by G. Lanza, P. Rothwell, and R. Spurr. [1961] 20p. (AFOSR-1617) (AF 49(638)555) Unclassified

In order to obtain solutions which are Lorentz invariant, the relativistic Boltzmann equation of Clemmow and Wilson together with Maxwell's equations are applied to a plasma in a constant magnetic field, assuming a variable density in the z direction and hence, a variable collision frequency. The assumption is that $E = e^{i\omega t}$ gives 2 fourth order differential equations which are solved for the plasma and electromagnetic modes, respectively. The modified solutions of the usual dispersion relations resulting from the Lorentz form and the assumptions of variable density and collision frequency are examined for an effective density gradient an possible coupling between the different types of waves. Finally, the mode properties are examined in the inertial frame of an observer moving with relative velocity with respect to the plasma.

2157

Northeastern U. Dept. of Physics, Boston, Mass.

ON THE STEADY-STATE DYNAMICS OF SPIRAL GALAXIES, by H. D. Greyber. June 1, 1962, 40p. incl. diagrs. tables, refs. (Scientific rept. no. 3) (AFOSR-2958) (AF 49(638)555) AD 285856 Unclassified

In the theory discussed, ideas of plasma physics and magnetohydrodynamics are invoked for explaining the general circulation of gas through a spiral galaxy. In particular, a general dipole magnetic field in the region close to the center of the galaxy (whose axis roughly coincides with that for the galaxy) is assumed and the consequences studied. Thus for the charged gas and dust, gravitational and magnetic forces are assumed to play comparable roles. Before discussing the theory however, the evidence for the structure of spiral galaxies is reviewed, especially in the neighborhood of the galactic center.

2158

Northeastern U. [Dept. of Physics] Boston, Mass.

RELATIVISTIC TREATMENT OF PLASMA, by G. Lanza and H. Yilmaz. Sept. 1, 1962 [8]p. (Scientific rept. no. 4) (AFOSR-2959) (AF 49(638)555) Unclassified

Presented at Internat'l. School of Physics "Enrico Fermi": Twenty-Fourth Course on Space Exploration and the Solar System, Varenna (Italy), June 4-16, 1962.

The equations of plasma physics are obtained from a few fundamental principles and in a relativistically covariant form. The general principles used are: (1) the relativistic invariance, (2) causality requirement, and (3) the positive definitiveness of energy. These are general statements which are valid for all phenomena, whether electromagnetic or not. In addition to these, the principles of charge conservation and of gauge invariance are employed to introduce electrodynamics. Other requirements, for example, the conservation of energy-momentum and angular momentum, etc. will not be considered as independent principles since these are the consequences of the homogeneity and isotropy of the Lorentz space.

2159

Northeastern U. Dept. of Physics, Boston, Mass.

[THEORY OF PLASMA OSCILLATIONS], by G. Lanza. Final rept. Sept. 30, 1962, 13p. incl. refs. (AFOSR-3899) (AF 49(638)555) Unclassified

The main objective of the study was to conduct research in the general field of plasma instabilities. Some of the topics covered are: (1) Normal mode treatments of pinch instabilities; (2) Magnetohydrodynamic shock waves; (3) Relativistic treatment of plasma; (4) Lorentz-invariant treatment of the propagation of EM waves in a plasma with a density gradient; (5) Steady-state dynamics of spiral galaxies; (6) Conventional and plasma thermocouples; (7) Calculation of thermopower factor for a plasma and a metal; and (8) Zeeman research.

2160

Northrop Corp., Hawthorne, Calif.

ELECTRICAL DISCHARGE ACROSS A SUPERSONIC JET OF PLASMA IN TRANSVERSE MAGNETIC FIELD, by S. T. Demetriades and P. D. Lenn. [1962] [3]p. incl. diagr. (AFOSR-J739) (AF 49(638)1160) AD 414144 Unclassified

Also published in AIAA Jour., v. 1: 234-236, Jan. 1963.

Observations were made of the discharge between 2 electrodes placed across a supersonic stream of ionized gas. A magnetic field transverse to both the flow direction and the electrode axes was applied. Visual observations of the behavior of the discharge with and without magnetic fields are described, and qualitative explanations of the observed phenomena are proposed. (Contractor's abstract)

2161

Northwestern U. Dept. of Astronomy, Evanston, Ill.

RESEARCH ON STELLAR IMAGE MOTION AND SCINTILLATION, by R. K. Woo and W. C. White. Final interim rept. Sept. 1, 1960-Aug. 31, 1961, Jan. 18, 1962. 3p. (AFOSR-2075) (AF 49(638)941) AD 273154 Unclassified

Detailed ch ..ber tests were conducted on the balloon-borne system prior to its actual usage. Following a series of delays, the system was put into use gathering ground-based scintillation, stellar motion and IR data.

2162

Northwestern U. Dept. of Chemistry, Evanston, Ill.

SYNTHESIS AND CHARACTERIZATION OF SOME DIACIDOTETRAAMMINERHODIUM (III) COMPOUNDS, by S. A. Johnson and F. Basolo. [1962] [8]p. incl. diagr. tables, refs. (AFOSR-2253) (AF 49(638)315) AD 407714 Unclassified

Also published in Inorg. Chem., v. 1: 925-932, Nov. 1962.

The synthesis of salts of the complex cations $[RhA_mCl_2]^+$, where A = NH_3, en, m-bn, d, l-bn, tetrameen, tren, or trien are described. Similarly, preparations are given for salts of the type $[Rh(en)_2X_2]^+$, where X = Cl^-, Br^-, I^-, NO_2^-, or N_3^-, and for those of the type $[Rh(en)_2XCl]^{+n}$ where X = SCN^-, NO_2^-, or NH_3. In most cases it was possible to isolate both the cis and trans isomers. Proof of structure for the isomers of $[Rh(en)_2Cl_2]^+$ was obtained by resolution of the cis form. In all other cases structural assignmen. was based on measurements of absorption spectra. For the $[RhA_mCl_2]^+$ systems there was the supporting evidence that the rates of hydrolysis of the trans isomers are not base-catalyzed, whereas the cis isomers hydrolyze more rapidly in alkaline solution. (Contractor's abstract)

2163

Northwestern U. Dept. of Chemistry, Evanston, Ill.

ACID CATALYSIS OF THE HYDROLYSIS OF ACIDOPENTAAMMINE COMPLEXES OF COBALT(III) RHODIUM(III) AND IRIDIUM(III), by F. Monacelli, F. Basolo, and R. G. Pearson. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-2376) (AF 49(638)315) AD 407710 Unclassified

Presented at meeting of the Italian Chem. Soc., Naples (Italy), May 1962.

Also published in Jour. Inorg. Nucl. and Chem., v. 24: 1241-1250, Dec. 1962.

The syntheses of $[M(NH_3)_5(RCOO)](ClO_4)_2$ where M = Rh(III) or Ir(III) and $RCOO^-$ = CH_3COO^-, $(CH_3)_3CCOO^-$ or CF_3COO^- are described. The rates of hydrolysis of these complexes as well as the corresponding Co(III) systems were determined in acid, $[H^+]$ = 0.01-0.1 M. In all cases the rates of hydrolysis increase with increase of acid concentration. The mechanism of acid hydrolysis of these systems is discussed. (Contractor's abstract)

2164

Northwestern U. Dept. of Chemistry, Evanston, Ill.

ACIDODIETHYLENETRIAMINEGOLD (III) COMPLEXES: PREPARATION, SOLUTION CHEMISTRY AND ELECTRONIC STRUCTURE, by W. H. Baddley, F. Basolo, and others. 1962, 34p. incl. diagrs. tables, refs. (In cooperation with Columbia U., New York) (AFOSR-4701) (AF 49(638)315) AD 407679 Unclassified

Also published in Jour. Inorg. Chem., v. 2: 921-928, Oct. 1963.

The preparation of acidodiethylenetriaminegold (III) salts with the general formula $[Au(dien)X]X_2$ (dien = $NH_2C_2H_4NHC_2H_4NH_2$ and X = Cl^- Br^-) is reported. The complexes are acids in aqueous solution, ionizing a proton from one of the amine nitrogen atoms. The resulting conjugate bases, $[Au(dien\text{-}H)X]X$ (dien-H) = dien less 1 proton and X = Cl^-, Br^-, I^- were isolated. Equilibrium constants for (N-H) ionization and for the hydrolysis are given. Electronic spectra of the $[Au(dien)X]^{2+}$ and $[Au(dien\text{-}H)X]^+$ complexes are assigned using a molecular orbital level classification. (Contractor's abstract)

2165

Northwestern U. Dept. of Chemistry, Evanston, Ill.

THE HYDROGENOLYSIS OF DICYCLOPROPYLMETHANE ON NICKEL CATALYSTS, by J. Newham and R. L. Burwell, Jr. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-2219) (AF 49(638)935) Unclassified

Also published in Jour. Phys. Chem., v. 66: 1438-1444, Aug. 1962.

This paper deals with the hydrogenolysis of dicyclopropylmethane (A) on nickel-silica, reduced nickel oxide, and nickel wire at 55° in a flow reactor. Diffusional control was negligible. Results differ in 2 major ways from those on platinum (see item no. 2166, Vol. VI), a much increased yeild of 2-methylhexane (E) and the intrusion of demethanation. E amounts to about 70% of the final heptane product which indicates that cleavage of the first and of the second rings occurs preferentially in opposite locations and, therefore, with some difference in mechanism. The double ring opening reaction via a surface reaction intercepts the formation of desorbed isobutylcyclopropane (C) to a much greater extent than on platinum. The large yield of E results from predominant cleavage of a bond adjacent to the side chain during the opening of the second ring. The mechanism of ring opening is discussed with the tentative conclusion that the initial ring opens via formation of 1,3-diadsorbed 2-substituted cyclopropane either by direct reaction of physically adsorbed A or from 1-monoadsorbed 2-substituted cyclopropane. The adsorbed species formed in this reaction either desorb or further react to open the second ring before desorption. About 10% of the initial ring cleavage leads to demethanation by breaking 2 bonds in the cyclopropyl ring. The effect of temperature upon selectivities is much smaller than on platinum. (Contractor's abstract)

2166

Northwestern U. Dept. of Chemistry, Evanston, Ill.

THE HYDROGENOLYSIS OF DICYCLOPROPYLMETHANE ON PLATINUM CATALYSTS, by J. Newham and R. L. Burwell, Jr. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-2220) (AF 49(638)935) Unclassified

Also published in Jour. Phys. Chem., v. 66. 1431-1438, Aug. 1962.

The hydrogenolysis of dicyclopropylmethane (A) has been studied in a flow reactor at 52°, $H_2/A = 16$, on coprecipitated platinum-alumina, 2 impregnated platinum-aluminas, platinum-pumice, and platinum-charcoal. Compound A hydrogenolyzes to butylcyclopropane (B) and isobutylcyclopropane (C). B further hydrogenolyzes to heptane (D) and 2-methylhexane (E); C to E and 2,4-dimethylpentane (F). The ratios B/C in the first reaction and D/E in the second are about 1/6 and E/F in the third is about 1/15, but there is some variation from catalyst to catalyst. Over half of the sequence A → B → D + E proceeds directly to D + E by a surface reaction which intercepts the formation of vapor phase B. The surface reaction is much less prominent in the sequence A → C → E + F. A very active impregnated platinum-alumina was investigated in 3 mesh sizes, 80-100, 40-60, and 20-40. The first behaved normally but the third gave much less C and a large initial ratio F/C. This behavior is diagnostic of large concentration gradients in the catalyst pores. The very active platinum-charcoal gave even more extreme behavior. The extreme cases of diffusional control do not agree very well with a model which assumes cylindrical pores. This matter and the effect of channelling upon selectivity are discussed. (Contractor's abstract)

2167

Northwestern U. Dept. of Chemistry, Evanston, Ill.

SYMMETRY NUMBERS AND REACTION RATES, by E. W. Schlag. [1962] [3]p. incl. diagrs. (AFOSR-J877) (AF AFOSR-62-83) AD 415837 Unclassified

Also published in Jour. Chem. Phys., v. 38: 2480-2482, May 15, 1963.

It is shown that absolute rate theory, in its use of symmetry numbers in the rotational partition functions, does not provide an infallible method for considering the possibility of multiple reaction paths. The conditions under which this method must fail are considered; and hence, in absolute rate theory calculations, a correction factor must be included beyond that provided by the symmetry numbers. A general method is given for calculating the reaction path multiplicity; a direct count of all possibilities will, of course, always provide the correct answer. (Contractor's abstract)

2168

Northwestern U. Dept. of Mathematics, Evanston, Ill.

AN ELEMENTARY PROBABILITY APPROACH TO FLUCTUATION THEORY, by S. C. Port. Mar. 15, 1962, 54p. incl. tables, refs. (AFOSR-3233) (AF 49-(638)877) AD 274019 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 6: 109-151, Feb. 1963.

Problems connected with the fluctuation of the sums of independent and identically distributed random variables are discussed. Basically these problems consist in finding the distribution of various functions which are definable in terms of the sums and which give a measure (in some sense) of the amount of oscillation which the sums undergo.

2169

Northwestern U. Dept. of Medicine, Chicago, Ill.

THE INTERACTION OF NONIONIC DETERGENTS WITH

PROTEIN IN PAPER ELECTROPHORESIS. by R. M. Dowben, W. R. Koehler, and G. Barrieux. [1961] [6]p. incl. diagrs. table, refs. (AFOSR-24) (AF 49-(638)821) Unclassified

Also published in Clin. Chem., v. 7: 482-487, Oct. 1961.

Addition of polyoxyethylene nonionic detergents to the buffer in paper electrophoresis results in alteration of the rate of migration and shape of protein peaks. At low detergent concentrations, disruption of paper-protein binding leads to faster migration and sharper peaks. At high detergent concentrations, interaction of detergent with protein leads to slower migration and broader peaks. On glass-fiber paper, which binds protein less strongly than ordinary cellulose filter paper, only slowing of migration occurs upon addition of detergent to the buffer. Electrophoresis of polysaccharides using buffer-containing detergent results in a slight increase in migration.

2170

Northwestern U. Dept. of [Metallurgy] and Materials Science, Evanston, Ill.

FORMATION AND REVERSION OF GUINIER-PRESTON ZONES IN Al-5.3% Zn, by H. Herman, J. B. Cohen, and M. E. Fine. Apr. 1962 [36]p. incl. illus. diagrs. tables, refs. (AFOSR-J46) (AF 49(638)524) AD 297259 Unclassified

Also published in Acta Metall., v. 11: 43-56, Jan. 1963.

Formation, reversion, and reformation of GP zones in Al-5.3 at.% Zn were studied through measurement of electrical resistance, Young's modulus, critical resolved sheat stress, and small-angle scattering of x-rays. A definite zone radius of approximately 9 A is associated with the resistance maximum or plateau which is observed during aging. This zone is independent of aging temperature or whether the zones form on aging or reaging after reversion. After a long aging treatment, about 1/2 of the Zn atoms present are associated with zones; after reaging only about 1/4 are associated with zones. The intensity maximum in the small-angle x-ray scattering curve early in the aging process is apparently due to a shell depleted in Zn about each zone. There is no incubation time for aging or reaging. The kinetics of formation of zones on aging and reaging depend upon vacancy concentration and supersaturation, these vary with aging temperature, time, and previous treatment. In the absence of a large excess in vacancies (this is the situation during aging or late in the direct aging process), the relation of the composition of the solid solution about the zone to the spinodal composition is particularly important and the rate of zone formation decreases with an increase in aging temperature. In the initial stages, when there are large numbers of vacancies, the rate increases with an increase in aging temperature. (Contractor's abstract, modified)

2171

Northwestern U. [Dept. of Political Science] Evanston, Ill.

CONCEPTUAL STRUCTURE AND GROUP PROCESSES IN AN INTERNATION SIMULATION. PART I. THE PERCEPTION OF SIMULATED NATIONS: A MULTIDIMENSIONAL ANALYSIS OF SOCIAL PERCEPTION AS AFFECTED BY SITUATIONAL STRESS AND CHARACTERISTIC LEVELS OF COMPLEXITY IN PERCEIVERS, by M. J. Driver. Apr. 1962 [356]p. incl. diagrs. tables, refs. (AFOSR-3439) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)742, Office of Naval Research, and National Institute of Mental Health) Unclassified

The purpose of the study was to uncover the general structure of the concept used to perceive social groups acting as simulated nations, to determine whether the complexity and content of this perceptual concept would shift under varying situational stresses and to discover whether differences in the complexity of this specific concept could be traced to a measure of generalized cognitive complexity. A model was presented in which complexity in a concept was defined in terms of 3 qualities: (1) amount of differentiation; (2) degree of representative integration; and (3) preponderance of internal dynamic properties of stimuli over more primitive external characteristics. The theory advanced was that complexity would relate to stress in a curvilinear fashion. Moderate stress should induce greater complexity in social perception than either too mild or too intense stress. In addition, it was expected that at most stress levels differences in complexity can be related to differences in the characteristic levels of cognitive complexity in perceivers. In general, the study found that by multidimensional scaling meaningful dimensions in the concept employed to perceive simulated nations could be discovered. It was also found that both content and structure in this social concept varied in provocative ways as a function of situational stress and characteristic levels of generalized complexity in perceivers. (Contractor's abstract, modified)

2172

Northwestern U. [Dept. of Political Science] Evanston, Ill.

INTER-NATION SIMULATION: AN EXAMPLE OF A SELF-ORGANIZING SYSTEM, by H. Guetzkow. [1962] [14]p. incl. refs. (AFOSR-J373) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)742 and AF AFOSR-62-63, and [Office of Naval Research]) AD 407630 Unclassified

Also published in Self Organizing Systems, Proc. of Conf., Chicago, Ill. (May 22-24, 1962), ed. by M. C. Yovits, G. R. Jacobi, and G. D. Goldstein. Washington, Spartan Books, 1962, p. 79-92.

Simulation is an operating representation of central features of reality. Simulations may take the form of war games, of pilot chemical plants, of computer-inventory systems. The efforts in simulation were stimulated by 2 streams of intellectual endeavor, one represented in the war game and the other deriving from the social

psychological group experiment. Events, as recorded in all their variety in historical and contemporary documents, are the usual basis for the development of theory about relations among nations. This theory must explain and eventually predict these international events.

2173

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

ELECTRON DENSITY AND COLLISION FREQUENCY OF ARC-HEATED ARGON PLASMA, by R. C. Warder, M. Brodwin, and A. B. Cambel. Jan. 1962, 63p. incl. illus. diagrs. tables, refs. (AFOSR-3045) (AF 49-(638)879) AD 276909 Unclassified

An investigation of the electrical properties of an argon plasma flow was conducted in an arc-heated plasma tunnel using microwave diagnostics. In particular, phase shift and attenuation measurements at 78 and 35.3 kmc were made to determine the electron density and electron collision frequency of the argon plasma. The electron densities as determined from the phase shift measurements at the 2 frequencies agree quite well and when compared with theoretical predictions indicate that the plasma flow is not in equilibrium. The attenuation measurements agree qualitatively; however, the experimentally derived electron collision frequencies do not agree with presently accepted theoretical predictions. Furthermore it has been shown that the infinite slab hypothesis which is assumed in many of the current microwave plasma studies was satisfied. The microwave interferometer method thus appears to be a reliable method for determining the electron density of plasma flows insofar as the infinite slab hypothesis is satisfied and the plasma electron density is below the cutoff value. (Contractor's abstract)

2174

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

THE EFFECT OF RADIATIVE LOSSES ON THE ATTENUATION OF ELECTROMAGNETICALLY DRIVEN SHOCK WAVES, by J. A. Thornton and A. B. Cambel. [1962] [13]p. incl. diagrs. refs. (AF 49(638)879) Unclassified

Published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 249-261, July/Sept. 1962.

The approximate, 1 dimensional blast wave theory of Harris is modified to take into consideration the effect of radiation losses from plasmas behind strong shock waves produced in electromagnetic shock tubes. The semi-empirical radiation theory of Kivel is used in evaluating the resulting modified shock expansion equation. The influence of various shock tube operating parameters such as energy input and ambient density on the shock wave velocity attenuation via radiation is examined. The predictions suggested by the proposed theory are confirmed by means of experimental data obtained in a conical discharge section electro-magnetic shock tube. It is seen that the most severe effect due to radiative losses occurs near the gaseous discharge. Radiation losses are found to be unimportant at distances downstream of the electrical discharge when the gas density is low. (Contractor's abstract)

2175

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

SOURCES OF ERROR IN THE MICROWAVE DIAGNOSTICS OF PLASMAS, by R. Warder, M. Brodwin, and A. B. Cambel. [1962] [3]p. incl. diagrs. [AF 49-(638)879] Unclassified

Published in Jour. Appl. Phys., v. 33: 2868-2870, Sept. 1962.

Errors in the microwave diagnostics of plasmas were investigated with the use of dielectric and conducting models. The results indicate that plasma property measurements utilizing reflection and transmission techniques are in considerable error for small samples and also that a planar analysis may not be used to infer the properties of a cylindrical plasma. (Contractor's abstract)

2176

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

THE SPECTROSCOPIC MEASUREMENT OF TEMPERATURE IN TRANSPARENT ARGON PLASMAS, by C. F. Knopp, C. F. Gottschlich, and A. B. Cambel. [1962] [3]p. incl. diagr. (AF 49(638)879) Unclassified

Published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 297-299, July/Sept. 1962.

In general, absorption spectroscopy is impractical in plasma diagnostics because the radiation intensities are quite high. Therefore, emission spectroscopy was used in this study. The technique described here is an adaptation of an astrophysical method developed originally by Fowler and Milne, and later treated analytically by Larenz for the case of transparent plasmas. The experimental utilization of the Fowler-Milne method is discussed and observations in connection with an argon arc jet are described. On the basis of these observations, it can be suggested that the method of Fowler-Milne may be used to advantage in determining the temperature of laboratory-type plasma arcs commonly used in studies of hypersonics and magneto-gasdynamic power generation.

2177

Northwestern U Gas Dynamics Lab., Evanston, Ill.

THERMOPHYSICAL PROPERTIES OF PLASMAS, by R. C. Warder and A. B. Cambel. Final rept. Mar. 15, 1960-Mar. 14, 1962. July 1962, 6p. incl. refs. (AF 49-(638)879) AD 283512 Unclassified

Current research is concerned with determining: (1) the kinetic coefficients for the recombination of ions and electrons, and the effect of radiative transfer to high

Mach number shock waves; (2) the effect of electron-neutral particle collision on the transmission and reflection of microwaves incident on the plasmas, and the tensor electrical conductivity of the plasma; and (3) the velocity distribution and thermal conductivity of a conventional plasma jet, and the electrical conductivity, and viscosity of a plasma as a function of its thermodynamic state.

2178

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

MICROWAVE DIAGNOSTICS OF ARC-HEATED PLASMA, by R. Warder, W. L. Nighan and others. [1962] [21]p. incl. diagrs. (AF 49(638)879 and AF AFOSR-62-307) Unclassified

Published in Symposium on Dynamics of Manned Lifting Planetary Entry, Philadelphia, Pa. (Oct. 1962), ed. by S. M. Scala, A. C. Harrison and M. Rogers. New York, Wiley and Sons, 1963, p. 185-205.

An investigation of the electrical properties of argon and nitrogen plasma flows have been conducted in arc-heated plasma tunnels using microwave diagnostics. In particular, phase shift and attenuation measurements at 78, 81.5, and 85.3 kmc have been made to determine the electron density and electron collision frequency of the plasma flows. The electron densities as determined from the phase shift measurements at the various frequencies agree quite well and, when compared with theoretical predictions, indicate that the plasma flow is not in equilibrium. The attenuation measurements agree qualitatively; however, the experimentally derived electron collision frequencies and hence, d-c conductivities do not agree with presently accepted theoretical predictions. Furthermore, it has been shown, the infinite slab hypothesis which is assumed in many of the current microwave plasma studies was satisfied. The microwave interferometer method thus appears to be a reliable method for determining the electron density of plasma flows.

2179

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

ONE-DIMENSIONAL MAGNETOGASDYNAMIC FLOW WITH WALL FRICTION, by S.-S. Liu and A. B. Cambel. [1962] [5]p. incl. diagr. table, refs. [AF AFOSR-62-307] Unclassified

Published in Phys. Fluids, v. 6: 792-796, June 1963.

The case of 1-dimensional magnetogasdynamic flow under the influence of wall friction is investigated. In particular, the case of an infinitely conducting, compressible plasma is studied when the flow direction and the direction of the magnetic field are at right angled to one another. It is shown that all flow variables can be expressed as functions of the ratio of the local flow velocity to the Alfvén velocity. It is shown that the flow has a variety of regimes delineated by specific singularities and extremities. A typical magnetogasdynamic Fanno flow chart is presented and it is noted that the flow differs markedly from that encountered in classical gasdynamics. (Contractor's abstract)

2180

Northwestern U. Technological Inst., Evanston, Ill.

INSTABILITY ANALYSIS OF CYLINDRICAL SHELLS UNDER HYDROSTATIC PRESSURE, by G Herrmann. [1962] [6]p. incl. tables, refs. (NASA technical note no. D-1510) (AFOSR-64-0135) (AF AFOSR-63-100) AD 436157 Unclassified

Also published in Proc. Nat'l. Aeronaut. and Space Admin. Conf. on Instability of Small Structures, Langley, Va., 1962, p. 239-244.

A general bending theory of circular cylindrical shells under the influence of initial stress is expressed to re-examine the theory and to compare the results with those of previous investigations. The outcome was the establishment of a simple but accurate expression for the buckling pressure applicable to a wide range of shell dimensions.

2181

Ohio State U. Research Foundation. Dept. of Chemistry, Columbus.

SYNTHESIS AND PROPERTIES OF HIGHLY HINDERED ALIPHATIC ACIDS, by M. S. Newman and T. Fukunaga. [1962] [3½p. incl. table, refs. (AFOSR-J682) (AF 33(616)3412) AD 412381 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1176-1178, Apr. 20, 1963.

The synthesis of several highly hindered aliphatic acids is described as well as certain reactions of these acids. The failure of triethylcarbinyl ditert-butylacetate to react with an amide ion provides an example of steric hinderance to proton removal. Ionization constants in 40% methanol at 40° for a number of hindered aliphatic acids have been determined and are listed. (Contractor's abstract)

2182

Ohio State U. Research Foundation. Dept. of Chemistry, Columbus.

THE CONDUCTANCE AND DIELECTRIC CONSTANTS OF SILVER IODIDE, SILVER IODOMERCURATE AND CUPROUS IODOMERCURATE, by P. Splitstone and P. M. Harris. Aug. 1962, 54p. incl. diagrs. tables, (AF 49(638)397) AD 289557 Unclassified

The capacitances and loss factors of β-Cu_2HgI_4 and AgI (as briquets) have been measured in the frequency range 10^2 to 10^5 cps and at each of several temperatures below room temperature. Arguments are presented to show that all 3 of these substances are not simple dielectrics but are characterized by relaxation processes having 2 (or more) relaxation times. In all 3 substances the magnitude of the conductance increases with frequency (at constant temperature) as would be expected of a substance whose polarization is accompanied by dissipation. It is suggested that transport and polarization by ion displacement occurs by escape of ions from tetrahedral sites of the iodine lattice to octahedral sites of the iodine lattice to octahedral sites in which the polarizability is expected to be much higher and that this escape probability may be greatly enhanced by the presence of anion defects.

2183

Ohio State U. Research Foundation. [Dept. of Chemistry] Columbus.

DESIGN OF AUTOMATED SINGLE CRYSTAL DIFFRACTOMETER FOR NEUTRON DIFFRACTION, by P. M. Harris. Aug. 1962, 17p. incl. diagrs. (Technical rept. no. 3) (AFOSR-4017) (AF 49(638)397) AD 285782 Unclassified

As neutron diffraction has been extended to investigations of the structures of more complex crystals, it has become necessary to collect measurements of a larger number of integrated reflections. The long counting times required have directed attention to the development of automated single crystal diffractometers. Because of the complexities and cost of the punched card or tape method of automation, it appeared worthwhile to survey more generally the possibilities available. This report describes 3 cases of practical importance; (1) normal beam method, (2) equi-inclination method, and (3) flat cone method. All 3 methods permit the mapping of a large number of reflections without reorientation of the crystal relative to the diffractometer axis. This is a great advantage as compared with the use of the crystal orienter since only 2 instead of 4 automated drives are required.

2184

Ohio State U. Research Foundation. [Dept. of Mathematics] Columbus.

NONLINEAR VIBRATING SYSTEMS HAVING INFINITELY MANY LIMIT CYCLES, by K. Klotter and E. Kreyszig. Final rept. Apr. 1962, 18p. incl. diagrs. (AF 49(638) 990) Unclassified

The paper contains an analytical investigation of the limit cycles of the system given by $\ddot{q} - (\mathrm{Sgn}\,\dot{q})\left(\frac{aK^2}{2}\dot{q}^2\cos aq + \frac{c^2}{2}\right) f(q) = 0$ with $a > 0$, $f(q)$ is an odd polynomial with nonnegative coefficients, and the constants are denoted in a fashion convenient for the system investigated. It is shown that limit cycles exist and can be characterized in detail without integrating the equation.

2185

Ohio State U. Research Foundation. Dept. of Physics [and Astronomy], Columbus.

INTERACTIONS BETWEEN ELECTROMAGNETIC RADIATION AND MATTER, by L. C. Brown. Final rept. June 1, 1953-Mar. 31, 1962. Apr. 28, 1962, 8p. incl. refs. (AFOSR-2583) (AF 18(600)772) AD 293205 Unclassified

This final report summarizes the research performed under this contract, and includes several reprints not distributed previously as technical notes. The research is divided into the following sections: (1) microwave absorption of gases; (2) electronic paramagnetic resonance; (3) nuclear quadrupole transitions; (4) nuclear magnetic resonances; and (5) theoretical studies. A brief review of each is given.

2186

Ohio State U. Research Foundation. [Dept. of Physics and Astronomy] Columbus.

A FOKKER-PLANCK EQUATION FOR SPIN RELAXATION, by A. Yoshimori and J. Korringa. [1962] 28p. incl. refs. (AFOSR-2586) [AF 49(638)264] Unclassified

Also published in Phys. Rev., v. 128: 1054-1060, Nov. 1, 1962.

A method is developed to describe the quantum mechanical motion of a few simple spin systems, with random time-dependent perturbations, in an exact manner, i. e. without reference to perturbation theory. It leads to a Fokker-Planck type diffusion equation. When applied to a spin influenced by a fluctuating local field (Abragam's model), this gives rise to a (microscopic) Bloch type equation for the spin operators. An application to a system of 2 identical spins (S = 1/2) with modulated dipole interaction produces a very complicated diffusion equation in 8 variables, which simplifies, however, in a case of restricted rotation. A model Hamiltonian for quadropole relaxation for S = 1 gives a relatively simple result, which reveals an interesting difference between the relaxation in finite and zero external fields. (Contractor's abstract)

2187

Ohio State U. Research Foundation. [Dept. of Physics and Astronomy] Columbus.

THEORY OF RELAXATION OF A TWO-SPIN SYSTEM, by J. Korringa and A. Yoshimori. [1962] [35]p. (AFOSR-2587) [AF 49(638)264] Unclassified

Also published in Phys. Rev., v. 128: 1061-1069, Nov. 1, 1962.

The relaxation of a system of 2 inequivalent spins (S = 1/2, I = 1/2) with 2 non-commuting time dependent interactions, i. e. a randomly modulated dipole interaction, and a fluctuating local field acting on one of the spins (S), is discussed. The influence of the fluctuating field is treated exactly in terms of a Fokker-Planck equation, which is described in the previous paper (item no. 2186, Vol. VI). The dipole interaction is then treated with perturbation theory. This gives, in all detail, the time dependent transitions between the levels established in a constant external field. It is shown that rate equations are insufficient to describe the transitions, and that in weak fields a resonance phenomenon can occur. This resonance is studied in some detail with Green's function methods. (Contractor's abstract)

2188

Ohio State U. Research Foundation. Dept. of Physics [and Astronomy] Columbus.

STUDY OF THE BEHAVIOR OF SOLIDS IN ALTERNATING AND CONSTANT MAGNETIC FIELDS, by J. Korringa. Final rept. Jan. 1, 1951-Sept. 30, 1962, 5p. (Rept. no. 19) (AFOSR-3528) (AF 49(638)264) AD 284808 Unclassified

This report lists 13 articles published as a result of research done under this contract.

2189

Ohio State U. Research Foundation. [Dept. of Physics [and Astronomy] Columbus.

THEORY OF ANTIFERROMAGNETIC SPIN WAVES IN SOME METAMAGNETIC CRYSTALS, by A. Yoshimori. [1962] [6]p. incl. diagr. tables. (AFOSR-J759) (AF 49(638)264) AD 414044 Unclassified

Also published in Phys. Rev., v. 130: 1312-1317, May 15, 1963.

The spin waves of metamagnetic hexagonal layer crystals, in particular, $NiCl_2$ and $CoCl_2$, are calculated in a semicontinuum model. Temperature variations of the specific heat and of the sublattice magnetization due to the spin-wave excitations are derived and discussed.

2190

Ohio State U. Research Foundation. [Dept. of Physics and Astronomy] Columbus.

A GENERALIZED MOLECULAR FIELD THEORY FOR ANTIFERROMAGNETISM, by R. P. Kenan. [1962] [2]p. incl. diagrs. [AF 49(638)264] Unclassified

Also published in Proc. Eighth Internat'l. Conf. on Low Temperature Phys., London (Gt. Brit.) (Sept. 16-22, 1962), Washington, Butterworths, 1963, p. 258-259.

In the perturbation term $V = 2Jzv\left[\sum_j a^+_j a_j + \sum_k a^-_k a_k\right]$, v has the value n, which is the exact expectation value of the number operator. This choice gives a perturbation theory over a molecular field theory more general than that of Néel. Results of calculating the total energy at low temperatures are given and compared with earlier theories.

2191

Ohio State U. Research Foundation [Dept. of Psychology] Columbus.

INDUCED COLLABORATION IN SOME NON-ZERO GAMES, by A. Scodel. 1962, 13p. (AFOSR-4206) (AF 49(638)317) AD 287838 Unclassified

Also published in Jour. Conflict Resolution, v. 6: 335-340, Dec. 1962.

Three kinds of 2-person non-zero-sum games were utilized in this study. Two of the games employed a matrix in which the competitive strategy did not dominate in a formal sense whereas the third involved a matrix of the dilemma variety in which the competitive strategy did dominate. In neither of the first 2 games was there any difference in the subjects' collaborative behavior for the 2 experimental conditions. Regardless of condition, however, subjects in these games manifested more collaboration than was true of games of identical matrices where pairs of subjects selected their own strategies. In the dilemma game, there was a pronounced difference between subjects under the 2 conditions - about half of the subjects exposed to the initially competitive stooge manifested collaboration in contrast to an almost complete absence of such behavior in those subjects who played with a collaborative stooge. The latter group played much like subjects playing the same game with other subjects. (Contractors abstract)

2192

Ohio State U. Research Foundation. Dept. of [Psychology] Columbus.

INTRA-ORGANIZATIONAL STRUCTURAL VARIATION: AN APPLICATION OF THE BUREAUCRATIC MODEL, by R. B. Hall. [1962] 22p. incl. refs. (AFOSR 2918) (AF 49(638)447) Unclassified

Ten organizations, 5 profit making and 5 governmental, were examined to determine whether or not variations in structure do occur between organizational segments engaged in divergent activities and whether such variations have any significant influence on the over-all organizational structure. The purpose was to set up scales for evaluating the degree of bureaucratization present in a given institution or segment thereof, and to determine the degree to which bureaucratic procedures might be incompatible with a given task. Six of the dimensions used as criteria were (1) a well defined hierarchy of authority, (2) a division of labor, (3) a system of rules covering rights and duties (4) a system of procedure, (5) impersonality, and (6) promotion and selection based on technical competance. It was found that tasks which require social or creative skills such as research, sales and design are not appropriately analyzed by the bureaucratic model. They are nonuniform or difficult to routinize and will be significantly less bureaucratic.

2193

Ohio State U. [Research Foundation] [Dept. of Psychology] Columbus.

ADMINISTRATIVE PRACTICES IN UNIVERSITY DEPARTMENTS, by E. Haas and L. Collen. [1962] [17]p. incl. table, refs. (AFOSR-2985) (AF 49(638)447) AD 288167 Unclassified

Also published in Admin. Sci. Quart., v. 8: 44-60 June, 1963.

This paper attempts to explain variation in the formalization of administrative practices current in the teaching departments of a large midwestern university. Variation was noted in the degree of formalization in the following practices: hiring procedures, evaluation of performers, and handling of satisfactory faculty members. This variation was analyzed to determine its relationship to: department size, frequency of decision making, department prestige, supply-demand ratio, and humanistic orientation. Frequency of decision making emerged as the most significant of these. Humanistic orientation was found to be associated with the subject matter taught by the department. (Contractor's abstract)

2194

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

LEARNING THEORY AND CLINICAL PSYCHOLOGY, by S. Liverant [1962] 35p. incl. refs. (AFOSR-2832) (AF 49(638)741) AD 612126 Unclassified

Also published in Prog. in Clin. Psychol., v. 5: 159-177, 1963.

Four conclusions about the reconciliation of learning theory and clinical psychology are offered. First, both behaviorists and clinical psychologists must overcome their traditional distrust of theory and come to a realization that the development of a constructural approach is to their mutual benefit and advancement. Second, the thrust of learning into clinical psychology has produced much questioning of clinical mythology, a procedure which is a necessary step in the progress of clinical psychology. Third, contact with clinical observation has in many instances forced the learning theorist to reexamine the narrowness of his formulations and has contributed to an awareness that imaginative conceptualization is prior to methodological ingenuity. Fourth, the strands of learning theory form a network of still tenuous strength, but one which offers a compelling approach to abnormal behavior and the clinician's interactions with the disturbed individual.

2195

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

THE PREDICTION OF SOCIAL ACTION TAKING BEHAVIOR, by P. M. Gore and J. B. Rotter. [1962] [12]p. incl. table, refs. (AFOSR-2833) (AF 49(638)741) AD 612125 Unclassified

Presented at meeting of the Midwestern Psychological Association, 1962.

Also published in Jour. Personality, v. 31: 58-64, Mar. 1963. (Title varies)

Students in a Southern Negro college (N - 116) very much involved in the current social protest movement against segregation were used as subjects of a study of prediction of social action taking behavior. A forced choice test of a generalized attitude toward internal or external control of reinforcements, not specifically dealing with the issue studied, predicted the type and degree of commitment behavior manifested to effect social change. The social desirability motive and social class showed a weak trend, in the predicted direction, in the case of the former and a logically consistent one on an ad hoc basis in the case of the latter. These findings may serve as an impetus for much needed research in the important area of ongoing social action and social change.

2196

[Ohio State U. Research Foundation. Dept. of Psychology, Columbus].

ALIENATION AND LEARNING IN A HOSPITAL SETTING, by M. Seeman and J. W. Evans. [1962] [11]p. incl. tables, refs. (AFOSR-2860) [AF 49(638)741] AD 414295 Unclassified

Also published in Amer. Sociol. Rev., v. 27: 772-782, Dec. 1962.

This paper presents a controlled, and situationally specific, test of a common assertion regarding alienation in modern society. The hypothesis is tested that differences in alienation (i. e., in powerlessness) are associated with differential learning of behavior-relevant information. Comparing patients who differ in their degree of alienation, but who are matched for socioeconomic backgrounds and for health and hospital histories, it is shown that the more alienated patients score lower on an objective test of knowledge about tuberculosis. Furthermore, these differences in objective knowledge are reflected in both the staff's description of the patients, and in the patients' attitudes about the information process. In understanding the attitude data, it is shown that the social structure of the ward as well as individual alienation must be taken into account. The relevance of these findings for contemporary viewpoints concerning the significance of alienation is noted.

2197

Ohio State U. [Research Foundation]. Dept. of Psychology, Columbus.

SOME FACTORS AFFECTING THE PERCEPTION OF EVENTS AS CHANCE DETERMINED, by S. Blackman. [1962] [6]p. incl. tables. (AFOSR-3703) [AF 49(638)741] Unclassified

Also published in Jour. Psychol., v. 54: 197-202, July 1962.

One hundred eighty students were exposed to series of red and green lights which appeared with equal frequency. The interest was on the effect of these variables on extinction of expectancies for success in predicting which light to expect. The conditions studied were, length of sequences of events, and whether the sequences were patterned. Ss were presented with varying series of red and green lights in training, then the red light stopped coming on. The major hypothesis states; Ss who received long sequences or patterned sequences of red and green lights will, when the red light stops coming on, have a lower expectancy for red than will Ss who receive short sequences or non-patterned sequences.

2198

Ohio State U. Research Foundation. [Dept. of Psychology] Columbus.

CONFORMITY UNDER VARYING CONDITIONS OF PERSONAL COMMITMENT, by D. P. Crowne and S. Liverant. [1962] [9]p. incl. tables, refs. (AFOSR-J1165) (AF 49(638)741) AD 423049 Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 66: 547-555, June 1963.

This study tested a central proposition, stemming from Rotter's social learning theory, that conformity is related to low expectations of success in socially evaluative situations and is consequently accompanied by defensive processes. Two variants of an Asch situation representing increasing degrees of personal commitment were compared to a control condition. Situational measures of confidence included betting and statements of expectancy. Additional personality indices included level of aspiration, need for approval, and internal vs external control of reinforcement. The Ss were 110 introductory psychology students. Results depict the conformer as one who has a low expectation of success in evaluative situations. His lesser confidence leads to avoidant behavior to resolve the ensuing conflict. Defensive processes of the conformer tend to become more marked as personal commitment increases.

2199

Oklahoma State U., Stillwater.

INVESTIGATION OF SEMICONDUCTING PROPERTIES OF TYPE IIb DIAMONDS, by W. J. Leivo, M. D. Bell and others. Final rept. May 1962, 224p. incl. illus. diagrs. tables, refs. (AFOSR-2642) (AF 18(603)40) AD 277416 Unclassified

A number of properties of semiconducting diamond have been investigated. The studies were concerned with optical transmission, rectification, photovoltaic effect, photoconductivity, mobility and activation energies of carriers, lifetimes and trapping of carriers, luminescence, and electron spin resonance. Also, a pulsed magnet and optical system for infrared cyclotron

resonance studies of crystals was designed and is under construction. (Contractor's abstract)

2200

Oklahoma State U., Stillwater.

IMPURITY DIFFUSION IN DIAMOND (Abstract), by W. J. Leivo and V. A. Fratzke. [1962] [1]p. [AF 18(603)40] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 436, Aug. 27, 1962.

The possibility of diffusing impurities into nonconducting diamonds under vacuum conditions in order to produce semiconducting diamonds was investigated. Diffusion experiments were carried out with Al, B, and Be at temperatures around 900°C which is below that at which the conversion rate of diamond to graphite becomes significant. Evidence of diffusion was determined by electrical-conductivity measurements, changes in optical absorption, and by comparison with natural semiconducting diamond. No detectable diffusion occurred in times up to 1 wk. The results are in accord with theoretical calculations of diffusion using a vacancy model for diffusion. The calculated activation energy is too high to give a measurable diffusion at 900°C in the time involved. The activation energy for diffusion of boron in diamond was computed; it is less than that for Al, and is essentially the same as for self-diffusion. The activation energy for self-diffusion using an extension of the method used by Dienes for diffusion in graphite was compared with that developed by Swalin for the diamond-type crystals.

2201

Oklahoma State U. Dept. of Chemistry, Stillwater.

VAPOR PRESSURES IN THE SYSTEM DI-N-BUTYL PHTHALATE DIETHYL ETHER AND A STUDY OF THE THERMOMETRIC METHOD FOR COMPARISON OF VAPOR PRESSURES, by T. E. Moore and R. J. Laran. [1962] 6p. incl. tables. (AFOSR-TN-60-579) (AF 18(600)478) Unclassified

The successful application of "wet-bulb" thermometry using thermistors as temperature-sensing elements in the determination of molecular weights of nonvolatile solutes in volatile solvents led to an investigation of the usefulness of the method for studying the thermodynamic properties of salts in ether. It was necessary to measure the vapor pressure of ether solutions of di-n-butyl phthalate over a wide range of concentrations to provide data for calibration of the thermometric apparatus. The measurements were made at 24 concentrations covering the range of ester mol-fractions from 0.006 to 0.175 at 25°. A static method employing a differential manometer and alternate freezing and thawing under evacuation was used. The solvent and solutions were stirred magnetically, and the temperature was controlled to ± 0.005°. Solutions were analyzed after mass measurement by evaporation to constant weight at 60-70°. A quadratic equation was fitted to the data by least squares procedure. $\Delta p = 0.43 = 33.64\ m - 2.478\ m^2$ The calibration data for solutions of di-n-butyl phthalate in ether show that ΔR varies linearly with Δp up to Δp equal to about 50 mm, with $\Delta R/\Delta p$ having a value of 4.38 ohms per mm. In order to evaluate the thermal efficiency of the method and compare this with the theoretical efficiency, the vapor pressure lowerings of ether corresponding to the measured temperatures of the solvent drop in the steady state were calculated from the known properties of ether. Values of the ratio of the calculated vapor pressure lowering to the vapor pressure lowering obtained from the calibration curve are shown.

2202

Oklahoma State U. Dept. of Chemistry, Stillwater.

THERMODYNAMIC PROPERTIES OF BINARY SULFIDES, by R. D. Freeman. Jan. 1962, 41p. incl. tables, refs. (AFOSR-2269) (AF 49(638)109) Unclassified

The thermodynamic properties of binary sulfides are presented. The review includes the mass of data published in the past decade, tabulates free energy functions, and incorporates recent information on the heat of formation of S(g).

2203

Oklahoma State U. [Dept. of Physics] Stillwater.

REDUCED WIDTHS IN O^{16} AND GAMMA TRANSITION PROBABILITIES IN F^{19}, by B. Roth and K. Wildermuth. [1960] [5]p. incl. tables, refs. [AF 49(638)907] Unclassified

Published in Nuclear Phys., v. 20: 10-14, Oct. 1960.

Reduced widths in O^{16} and γ- transition probabilities in F^{19} qualitatively predicted by the cluster model, are compared with experimental data. (Contractor's abstract)

2204

Oklahoma State U. [Dept. of Physics] Stillwater.

THEORY OF He^+ - He COLLISIONS AT KILOVOLT ENERGIES, by B. Roth. [1962] [23]p. incl. diagrs. refs. (AFOSR-2106) (AF AFOSR-62-102) AD 611287 Unclassified

The cross section for the scattering of He^+ ions by He atoms in the kv energy range is calculated using only Coulomb interactions. Effects due to electron exchange,

antisymmetry in the 3 electrons and a center of mass correction are found to be important and are taken into account. The differential cross section summed over all states of excitation is sensitive to the wave function used for the He ground state. Calculations are made for 2 different wave functions, and the results are compared with experiment. (Contractor's abstract)

2205

Oklahoma State U. [Dept. of Physics] Stillwater.

ATOMIC COLLISIONS, by B. Roth. Final technical rept. Aug. 1962, 2p. (AFOSR-3533) (AF AFOSR-62-102) AD 285405 Unclassified

The problem of electron exchange in H^+ -H collisions was first investigated on a purely quantum mechanical basis. A calculation was made using the method of distorted waves. The 2 scattered waves, the one for non-capture and the other for capture (the electron being in the ground state in both cases), are coupled by the nucleus-electron interaction. Interference between these 2 waves gives rise to resonances. Calculation gives, for the energies of these resonances, values which agree exactly with 4 experimentally determined resonances in the range 0.5 to 50 kev. The resonances do not reach their maximum values (a probability of 1 or 0 for capture) as there is some damping. The interaction which gives rise to the resonance is a complex quantity.

2206

Oklahoma U. [Dept. of Physics] Norman.

THE DETERMINATION OF OPTICAL EXCITATION CROSS SECTIONS IN ATOMIC GASES, by R. M. St. John and C. C. Lin. Final rept. Jan. 3, 1962, 6p. incl. tables. (AFOSR-1992) (AF 49(638)41) Unclassified

A brief description of the work dealing with the determination of optical excitation cross-sections in atomic gases is given. Most early investigations dealt with the study of the 3^1p level of He and the effects of resonance radiation. Later studies dealt with excitation transfers of ^3D levels at high pressure. The theory of multiple transfer of excitation through high energy levels was developed to account for the shape of the excitation function. In 1961 a new system for processing excitation function data was constructed and developed, the basis of which is the display of the apparent cross section on an oscilloscope screen as a function of the electron energy. It is permanently recorded by a camera. Also the quantum mechanics theory of the multiple state transfer mechanism has been investigated in detail.

2207

Oklahoma U. Dept. of Physics, Norman.

THEORY OF MULTIPLE STATE TRANSFER IN HELIUM AND OBSERVATION RELATIVE TO IT, (Abstract) by R. M. St. John, C. C. Lin, and R. G. Fowler. [1962] (AF 49(638)41) Unclassified

Published in Second Internat'l. Conf. on Physics of Electronic and Atomic Collisions; Abstracts of Papers, Colorado U., Boulder (June 12-15, 1961), New York, W. A. Benjamin, 1961, p. 123. (AFOSR 1327)

Excitation in helium is readily shifted from ^1P states to ^3D states at pressures as low as 10^{-2} mm. It is assumed in a new theory that low lying ^3D states receive population through radiative transitions from many higher ^3F states. An nth ^3F state is largely populated from the nth ^1P state through a collision of a ground state helium atom with an n^1p to n^3F is assumed to have either an n^2 or an n^4 variation. Refinements of the theory were made and the theory fitted to experimental observations of 3^3D density at a single pressure for each assumption. Recent observations on population densities of 4^3D and 5^3D are compared with the predictions of the above theory with its various assumptions. The theory yields cross sections for transfer of excitation from ^1P states to ^3F states (and the reverse process) which are near the gas kinetic value and hence are in relatively good agreement with the Wigner spin rule. Quantum-mechanical calculations of the cross sections have been made and the results compare favorably with experiments.

2208

Oklahoma U. [Dept. of Physics] Norman.

MEASUREMENT OF THE RELAXATION TIMES FOR THE OPTICAL EXCITED STATES OF ATOMS, by R. G. Fowler. Interim final rept. May 31, 1962, 5p. (AF 49(638)639) (AFOSR-4043) Unclassified

This research on transition probabilities emphasizes absolute magnitudes and the factors which govern them. A low pressure gas is excited to an equilibrium condition, then the excitation source is removed abruptly and the relaxation in the luminosity of a single spectral line is observed photoelectrically. The information is displayed on an oscilloscope and photographed for analysis. The rather small amount of light available is a matter of some concern so a second standby absolute experiment was begun. In either experiment complete success will depend on an understanding of the migration of radiation through a gas. Experiments have thus

been undertaken on the escape of mercury resonance radiation from a uniformly excited vessel to determine temperature dependence, effect of foreign gas, and effect of apparatus dimensions. A time calibration technique has been developed for kilomegacycle oscilloscopes. A complete working apparatus system has been set up for direct time constant measurement. It has been demonstrated that the time constant for migration of resonance radiation varies inversely as the square root of the temperature. Equipment is available for measurements of resonance radiation transfer time, lithium lifetimes and molecular dissociation.

2209

Oklahoma U. Dept. of Physics, Norman.

COLLISIONAL EXCITATION TRANSFER TO THE $4\,^1D$ STATE IN HELIUM BY MULTIPLE STATE MECHANISM, by C. C. Lin and R. M. St. John. [1962] [5]p. incl. diagrs. tables, refs. (AFOSR-J67) (AF AFOSR-62-67) AD 400375 Unclassified

Also published in Phys Rev. v. 128: 1749-1753 Nov. 1962.

The electron-excitation function of the $4\,^1D$ state of helium was measured at various pressures by means of an automatic processing system. The peak of the curve shifts gradually from 50 ev to 100 ev as the pressure is increased due to the collision transfer from the ^1P state. The transfer can be explained by the multiple state mechanism. Based on this theory the calculated population of the $4\,^1D$ state at $7.4 \times 1/10^{-2}$ mm pressure agrees quite well with experiments. The observed amount of transfer from $n\,^1P$ states to $4\,^1D$ and to $4\,^3D$ are of the same order of magnitude as predicted by the theory. The results of this work provide strong support for the multiple state transfer process. (Contractor's abstract)

2210

Oklahoma U. Dept. of Physics, Norman.

SYSTEM FOR PROCESSING AND RECORDING EXCITATION FUNCTION DATA, by R. M. St. John, C. C. Lin and others. [1962] [6]p. incl. diagrs. refs. (AFOSR-J126) (AF AFOSR-62-67) AD 400190 Unclassified

Also published in Rev. Scient. Instr., v. 33: 1089-1094, Oct. 1962.

A system which automatically processes optical excitation data is described. This system is capable of producing data faster and of better quality than the old method. The apparent cross section for excitation by electron impact of a particular state is proportional to the light intensity of a radiative transition from this level divided by the product of the electron beam current times pressure. The light intensity is measured from the output current of a photomultiplier tube. When the pressure in the collision chamber is maintained constant, the apparent cross section is proportional to the ratio of photomultiplier current to electron beam current. This ratio is continuously computed by an analog divider while the electron accelerating voltage power supply is slowly swept through its range by a motor and gear reduction system so as to give a visual display of the excitation function on an oscilloscope. Permanent records of the function are made by photographing the trace. Absolute values of the excitation function can be obtained by calibration against a standard lamp. In order to suppress noise and light signals not originating in the collision chamber, the light beam from the collision chamber is square wave modulated; this then is converted into a sinusoidal wave by means of a tuned amplifier. This in turn is rectified by a phase-sensitive detector which produces a dc voltage proportional to the signal light intensity. Circuits of the phase-sensitive detector and modulation unit are presented. (Contractor's abstract)

2211

Oklahoma U. [Dept. of Physics] Norman.

CROSS SECTIONS FOR INELASTIC COLLISIONS UNDER NEAR RESONANCE CONDITION-2S-2P TRANSITIONS IN He BY ELECTRON IMPACT (Abstract), by N. F. Lane and C. C. Lin. [1962] [1]p. [AF AFOSR-62-67] Unclassified

Presented at meeting of the Amer. Phys. Soc., Boulder, Colo., Oct. 10-12, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 642, Dec. 27, 1962.

A method for the calculation of cross sections of inelastic electron- atom collisions for the case of near-resonance is presented. By means of the standard partial-wave method, the Schrödinger equation can be reduced approximately to a series of pairwise-coupled differential equations which contain the matrix elements of the interaction potential of the 2 colliding system (of distance R apart) between the initial (i) and final (f) state such as $U_{ii}(R)$, $U_{ff}(R)$, and $U_{if}(R)$. In this method, the functions U_{ii} and U_{ff} are approximated by the form of $B(>^{-1} - R_0^{-1})$ with a cutoff distance R_0, while U_{if} is replaced by AR^{-2} for $R > R_c$ and a constant for $R < R_0$.

The partial cross sections for $l > 8$ calculated by this procedure agree quite well with those obtained from Seaton's schematic model. For smaller values of l, a considerable difference in the partial cross sections is found. The total cross sections for the $2\,^1S - 2\,^1P$, $2\,^3S - 2\,^3P$ transitions in He calculated by this improved inexact-resonance method are appreciably smaller than the corresponding values obtained by Born's approximation and by Seaton's close-coupling formula.

2212

Oklahoma U. [Dept. of Physics] Norman.

PRESSURE DEPENDENCE OF EXCITATION FUNCTIONS OF THE 4^1D, 4^3S, AND 3^3P STATES IN HELIUM (Abstract), by R. M. St. John and C. C. Lin. [1962] [1]p. [AF AFOSR-62-67] Unclassified

Presented at meeting of the Amer. Phys. Soc., Boulder, Colo., Oct. 10-12, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 642, Dec. 27, 1962.

The excitation function of the 4^1D state of helium has been measured at various pressures. The peak of the curve shifts gradually from 50 to 100 ev as the pressure is increased. This can be explained by the collisional transfer of excitation from the ^1P states through the multiple-state mechanism. Based on this theory, the calculated population of the 4^1D state agrees quite well with experiments. The effect of direct transfer from 4^1P is found to be much weaker than that of the multiple-state process. The excitation functions of the 3^3P and 4^3S states at pressures about 0.1 mm show a secondary peak at 50 ev similar in shape to the excitation function of the 4^1D state at low pressure. Preliminary analysis indicates that this secondary peak can be explained by assuming a transfer from the high level ^1D to ^3D states in addition to the stronger multiple-state transfer $n^1P \rightarrow nF$. The spin-orbit interaction produces a small amount of singlet-triplet mixing which leads to substantial cross sections for $n^1D \rightarrow n^3D$ transfer because of the extremely close resonance.

2213

Oklahoma U. [Dept. of Physics] Norman.

STUDY OF RESONANCE RADIATIVE TRANSFER (Abstract), by H. Mochizuki. [1962] [1]p. [AF AFOSR-62-67] Unclassified

Presented at meeting of the Amer. Phys. Soc., Boulder, Colo., Oct. 10-12, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 643, Dec. 27, 1962.

Experimental investigations have been made of mercury 2537A radiation transfer through a slab of mercury gas at various densities, by using a sinusoidally modulated (~10 kcps) radio-frequency-excited (50 mcps) source of 2537A radiation. Transmitted radiation has been found to gain in phase relative to the source wave, while that which is scattered at 90° loses phase. A different density dependence is observed for the 2 modes of observations.

2214

Oklahoma U. [Dept. of Physics] Norman.

A SYSTEM FOR PROCESSING AND RECORDING EXCITATION FUNCTION DATA (Abstract), by R. M. St. John. [1962] [1]p. [AF AFOSR-62-67] Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 115, Feb. 23, 1962.

A system has been developed which automatically processes and records data obtained in optical excitation experiments. In experiments of excitation by electron impact in a constant density gas, cross sections are proportional to the ratio of the light yield from the collision chamber to the electron current passing through the chamber. The light beam from the chamber is chopped 150 times/sec. The square wave response of the photomultiplier is amplified with a tuned amplifier; the tuned output is detected by a phase sensitive detector which produces a dc voltage proportional to the light intensity. This dc voltage is divided by a voltage proportional to the electron beam current, by means of an analog computer, giving a voltage proportional to the cross section for excitation. The energy of the exciting electrons is slowly swept through a range of 500 v. The computer output and electron accelerating voltage are fed to an oscilloscope in order to display the excitation function. A camera attached to the oscilloscope records the trace.

2215

Oklahoma U. [Dept. of Physics] Norman.

DISSOCIATION OF MOLECULAR HYDROGEN IN ELECTRIC DISCHARGES (Abstract), by S. B. J. Corrigan. [1962] [1]p. [AF AFOSR-62-378] Unclassified

Presented at meeting of the Amer. Phys. Soc., Boulder, Colo., Oct. 10-12, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 637, Dec. 27, 1962.

This paper presents improved experimental values of the electron-impact dissociation coefficient for molecular hydrogen in the range of reduced electric fields $x/P = 12\text{-}100$ v cm^{-1} (mm Hg)$^{-1}$. The measurements were made both in low-current rf discharges and in uniform positive columns. The dissociation coefficients obtained in these 2 ways are in good mutual agreement, and, as regards order of magnitude, are consistent with earlier published data. Reasons are given for assuming that the electron-energy distribution in this gas is closely Maxwellian, and this assumption is used to derive dissociation cross sections consistent

with the observed discharge-rate coefficients. Some more-tentative experimental data for dissociation rates in molecular oxygen are also presented.

2216

Olin Mathieson Chemical Corp., New Haven, Conn.

THE REACTION OF HYDROGEN ATOMS WITH LIQUID OZONE, by J. A. Wojtowicz, F. Martinez, and J. A. Zaslowsky. [1962] [4]p. incl. diagrs. tables. (AFOSR-J1471) (AF 29(600)1667) AD 427637 Unclassified

Also published in Jour. Phys. Chem., v. 67: 849-852, Apr. 1963.

The reaction of atomic hydrogen with liquid ozone at - 196° gives a product which upon warming evolves molecular oxygen and leaves a residue of aqueous hydrogen peroxide. It is shown that under certain reproducible conditions the ratio of evolved oxygen to residual hydrogen peroxide is unity. The absence of hydrogen peroxide as a primary reaction product (under these conditions) was confirmed by infrared examination.

2217

Olin Mathieson Chemical Corp., New Haven, Conn.

X-RAY STUDIES ON THE PRODUCT OF THE REACTION OF ATOMIC HYDROGEN AND LIQUID OZONE, by F. Martinez, J. A. Wojtowicz, and J. A. Zaslowsky. [1962] [3]p. incl. diagr. table. (AFOSR-J1473) (AF 49(638)1137) AD 426554 Unclassified

Also published in Jour. Phys. Chem. v. 67: 714-716, Mar. 1963.

This paper describes the results obtained by x-ray examination of the hydrogen atom-liquid ozone product in an attempt to identify the postulated product. The intent of these experiments was to determine if a superoxidic species could be detected in the frozen matrix of the hydrogen atom-ozone reaction product and to ascertain whether hydrogen peroxide is present. Although no proof for the presence of a new peroxide was obtained, the absence of hydrogen peroxide suggests that a higher unstable peroxide is the progenitor of the hydrogen peroxide which is detected on warming.

2218

Oregon U. Dept. of Chemistry, Eugene.

POLAROGRAPHIC REDUCTION OF SOME ALKYL- AND POLYMETHYLANTHRACENES, by L. H. Klemm, A. J. Kohlik, and K. B. Desai. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-2606)(AF 49(638)473) AD 612345 Unclassified

Also published in Jour. Org. Chem., v. 28: 625-630, Mar. 1963.

Polarography was conducted on anthracene, 10 monoalkylanthracenes, and 9 di- and polymethylanthracenes in 0.1 M tetra-n-butylammonium iodide in 75% dioxane-water. Using anthracene as a standard of comparison the change in the half-wave reduction potential, $-\Delta E_{1/2}$, for the single wave obtained for each of the other compounds is positive, consistent with a decrease in ease of electroreduction due to alkyl substitution. For isomeric monoalkyl derivatives, $-\Delta E_{1/2}$ is found to vary with the position of substitution in the manner 2- >1- >9-. Plots of $-\Delta E_{1/2}$ vs σ^*, the polar substituent constant, for the 2- and for the 1- plus 9-series are linear. There is no indication of a steric effect due to the bulkiness of the alkyl group. For those compounds containing more than one methyl substituent (investigated for 8- and/or meso-substituents only) a strict additivity relationship in $-\Delta E_{1/2}$ exists, except for the single change of 9-methylanthracene → 9, 10-dimethylanthracene, for which an enhancement potential must be included in order to retain additivity. Comparison of data indicates that $-E_{1/2}$ bears no simple relationship either to the frequency of the p-band (or other band) in the ultraviolet absorption spectrum or to the methyl affinity of the compound. In general, however, $-E_{1/2}$ bears an inverse relationship to the predicted value for the ionization potential. Syntheses of many of the compounds used are presented and discussed. (Contractor's abstract)

2219

Oregon U. Dept. of Chemistry, Eugene.

COPLANARITY EFFECTS ON THE SPECTRAL, GAS CHROMATOGRAPHIC, POLAROGRAPHIC, AND DIELS-ALDER CHARACTERISTICS OF 1-ALKYL-1-(2-NAPHTHYL)ETHENES, by L. H. Klemm, W. C. Solomon, and A. J. Kohlik. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-4081) (AF 49(638)473) AD 296207 Unclassified

Also published in Jour. Org. Chem., v. 27: 2777-2786, Aug. 1962.

Syntheses of a series of 1-alkyl-1-(2-naphthyl)-ethenes (where the alkyl group R = Me, Et, n-Pr, i-Pr, and t-Bu) from alkyl 2-naphthyl ketones by Grignard and Wittig methods are described. Comparison of ultraviolet absorption spectra of the alkenes shows a shift to higher frequency of the major absorption maximum of the order t-Bu > > i-Pr >n-Pr = Et = Me > H (taken as standard). From general appearances of the spectra and examination of molecular models, it is presumed that the average inherent angles of twist in these molecules follow the order t-Bu >> i-Pr >n-Pr = Et >Me > H (virtually coplanar). Polarographic reduction of the alkenes gives 2 waves at potentials of E1/2' (first wave, reduction of alkenyl double bond) and E1/2' (second wave, reduction of naphthalene nucleus)

2220

Oregon U. [Dept. of Mathematics] Eugene.

ONE-DIMENSIONAL TOPOLOGICAL SEMILATTICES, by L. W. Anderson and L. E. Ward, Jr. [1959] [5]p. (AFOSR-3608) (AF 49(638)889) Unclassified

Also published in Illinois Jour. Math., v. 5: 182-186, June 1961.

For abstract see item no. 1948, Vol. IV.

2221

Oregon U. [Dept. of Mathematics] Eugene.

[ORDERED TOPOLOGICAL LATTICES], by L. E. Ward, Jr. Final letter rept. June 1, 1960-May 31, 1962. June 8, 1962, 2p. (AFOSR-64-0062) (AF 49(638)889) Unclassified

The research objectives of the project were to investigate the inherent order structure of arcwise connected continua, and to employ that structure to solve various fixed problems. Nine publications enumerated in the report resulted from this project.

2222

Oregon U. [Dept. of Mathematics] Eugene.

EXISTENCE OF CONTINUOUS LATTICE HOMOMORPHISMS, by L. W. Anderson, [1962] [3]p. (AF 49(638)889) Unclassified

Published in Jour. London Math. Soc., v. 37: 60-62 1962.

A topological lattice is a Hausdorff space L and a pair of continuous lattice operations $\wedge$, $\vee : L \times L \to L$. Denote by I the unit interval, and by Hom (L, I) the continuous lattice homomorphisms of L into I. The breadth of L, denoted Br(L), is the smallest integer such that if $A \subset L$ is finite, then there is $B \subset A$ such that $B \leq n$ and AB. Theorem: If L is a compact connected distributive topological lattice with Br(L) finite, then Hom(L, I) distinguishes points. It is known that a compact, connected, finite-dimensional, distributive topological lattice has finite breadth. It follows that if L is locally compact, connected and distributive, then Hom(L, I) distinguishes points. The question remains: If a continuous curve is a distributive lattice of breadth n, can it be embedded topologically and algebraically in an n-cell. (Math. Rev. abstract)

2223

Oregon U. [Dept. of Mathematics] Eugene.

FIXED POINT THEOREMS FOR PSEUDO MONOTONE MAPPINGS, by L. E. Ward, Jr. [1962] [4]p. (AF 49(638)889) Unclassified

Published in Proc. Amer. Math. Soc., v. 13: 13-16, Feb. 1962.

A continuous function $f: X \to Y$ is called pseudo-monotone if, whenever A and B are closed, connected subsets of X and Y, respectively, and $B \subset f(A)$, then f maps some component of $A \cap f^{-1}(B)$ onto B. (In general, not every monotone map is pseudo-monotone.) Extending an argument of J. L. Kelley, the author proves the following theorem: If X is a continuum and $f: X \to X$ is pseudo-monotone, then X contains a non-empty subcontinuum Y which is minimal with respect to being invariant under f. In particular, if each non-degenerate subcontinuum of X has a cut point, and if f is monotone, then f has a fixed point. A generalization is also given. (Math. Rev. abstract)

2224

Oregon U. [Dept. of Mathematics] Eugene.

A STRUCTURE THEOREM FOR TOPOLOGICAL LATTICES, by L. W. Anderson and L. E. Ward, Jr. [1960] [3]p. (AF 49(638)889) Unclassified

Published in Proc. Glasgow Math. Assoc., v. 5: 1-3, Jan. 1961.

A subset K of a partially ordered set S is said to be ordered-dense if whenever $a < b$ are elements of K, there exists $C \in K$ with $a < c < b$. Theorem 1: If S is a connected locally compact, topological Λ-semilattice with zero element 0, in which every element has arbitrarily small order-dense neighborhoods, then every element $x \in S$ can be joined with 0 by a connected chain. Corollary: In a connected locally compact, topological lattice any two elements $a \leq b$ can be joined by a connected chain. Theorem 2: Every arcwise connected topological Λ-semilattice S with 0 is simply connected. In particular, the assumptions of this theorem are true if S satifies the assumptions of Theorem 1 and is metric. (Math. Rev. abstract)

2225

Oregon U. [Dept. of Mathematics] Eugene.

SYMMETRIC EXTERIOR DIFFERENTIATION AND FLAT FORMS, by V. L. Shapiro. [1960] [8]p. (AFOSR-3230) (AF 49(638)988) Unclassified

Also published in Canad. Jour. Math., v. 14: 79-86, 1962.

Let ω be a continuous differential r-form defined in a bounded domain R of Euclidean n-space, E^n, where $n \geq 1$ and $0 \leq r \leq n - 1$. ω is called a flat form in R, if there exists a constant N such that

$|\int \partial\sigma\omega| \leq N\,|\sigma|$ for every $(r+1)$-simplex σ contained in R, where $|\sigma|$ designates the $(r+1)$-volume of σ. For n = 1 and ω a zero form, flatness is the same thing as the usual Lip 1 condition. A necessary and sufficient condition that a continuous real-valued function of one variable f(x) satisfy a Lip 1 condition over an interval (a, b) is that its upper and lower symmetric derivatives be bounded in (a, b). This paper proves the analogue of this result for r-forms; in particular, the following theorem: Let ω be a continuous differential r-form defined in a bounded domain R of E^n. A necessary and sufficient condition that ω be flat in R is that its upper and lower symmetric exterior derivatives be bounded in R.

2226

Oregon U. [Dept. of Mathematics] Eugene.

THE UNIQUENESS OF FUNCTIONS HARMONIC IN THE INTERIOR OF THE UNIT DISK, by V. L. Shapiro. [1962] [14]p. (AFOSR-J1267) (AF AFOSR-62-82) AD 424232 Unclassified

Presented at meeting of the Amer. Math., Soc., Vancouver (Canada) Aug. 30, 1962.

Also published in Proc. London Math. Soc., v. 13: 639-652, Oct. 1963.

Let $f(r, \theta)$ be harmonic in the unit disk $0 \leq r < 1$, and let $\|f(r, \theta)\| = \max_\theta |f(r, \theta)|$. Let $f^*(\theta) = \lim \sup_{r \to 1} f(r, \theta)$, and let $f_*(\theta)$ be the lim inf. The author proves the following main theorem. Suppose $\|f(r, \theta)\| = o[(1-r)^{-2}]$. Let E be a countable subset of $[0, 2\pi)$ such that $f^*(\theta)$ and $f_*(\theta)$ are finite on $[0, 2\pi) - E$ and of class L^1 on $[0, 2\pi)$. Suppose further that $(1-r) f(r, \theta) \to 0$ for each θ in E. Then $f^*(\phi) = f_*(\theta)$ a. e. and $f(r, \theta) = \pi^{-1} \int_0^{2\pi} P(r, \theta-\phi) f^*(\phi)\, d\phi$, where P is the Poisson kernel. There is a very elegant corollary: If $\|f(r, \theta)\| = o[(1-r)^{-2}]$ and $f(r, \theta) \to 0$ for every θ, then $f(r, \theta) \equiv 0$. Simple examples show this latter result to be best possible in three different ways: "o" cannot be weakened to "O", "every θ" cannot be replaced by "every θ but one", and the L^∞ norm cannot be replaced by any L^p norm $\|f(r, \theta)\|_p$, $p < \infty$. However, the main theorem (and hence the corollary) still holds if the estimate for $\|f(r, \theta)\|$ is generalized to $\|f(r, \theta)\|_p = o[(1-r)^{-2 + 1/p}]$. (Math. Rev. abstract)

2227

Oregon U. [Dept. of Mathematics] Eugene.

THE CIRCULATION OF VECTOR FIELDS, by V. L. Shapiro. [1962] 7p. (AFOSR-64-0121) (AF AFOSR 62-82) AD 432572 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 818-822, Oct. 1963.

Let v be a continuous vector field in an open set R of 3-space and let $F(p, r, n) = \pi^{-1} r^{-2} \int (v, t)\,ds$; here the line integral is taken on a circle C with radius r, center at p, unit tangent vector t, in a plane whose unit normal is n, oriented in respect to C by a right hand rule. Let $D_n^* v(p)$ and $D_{*n} v(p)$ denote the lim sup and lim inf, respectively, of F(p, r, n) as $r \to 0+$. Let e_1, e_2, e_3 be unit vectors along fixed rectangular coordinate axes. It is shown that if $D_n^* n(p)$ and $D_{*n} v(p)$ are bounded for p in R and $n = e_1$, e_2, e_3 then for almost every p in R there is a vector w (interpreted as curl v) such that $F(p, r, n) \to w$ as $r \to 0+$, uniformly in n. It is remarked that Stokes theorem holds under the hypothesis stated, with w as curl v. (Math. Rev. abstract)

2228

Oregon U. Dept. of Physics, Eugene.

OPTICAL AND ESR SPECTRA OF IRRADIATED CaO CRYSTALS, by J. C. Kemp and V. I. Neeley. [1962] [2]p. incl. diagrs. (AFOSR-J542) (AF AFOSR 62-180) AD 408016 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 332-333, Feb. 1963.

The optical spectrum of a single crystal of CaO before and after irradiation with 10^{19} nvt fast neutrons is compared with that of MgO. It is concluded that the optical data and the ESR results are consistent with the fact that the 1.90 ev band in CaO is due to positive-ion vacancies at 300.77° and 4.2°K., except for a T_1 increase at 4.2°K. Spin density of samples that received 10^{19} nvt was 3×10^{18}/cc in CaO and 1×10^{18}/cc in MgO. The strongest visible peak (1.90 ev) in CaO was down 65% at 350°C; the ESR signal, only 8%.

2229

Oslo U. Inst. for Theoretical Physics (Norway).

[ON THE PRACTICAL SOLUTION OF RELATIVISTIC SINGLE ELECTRON EQUATION. II] Zur praktischen Lösung der relativistischen Einelektronengleichung. II, by E. A. Hylleraas. [1961] [14]p. [AF 61(052)134] Unclassified

Published in Zeitschr. Phys. v. 164: 493-506, Oct. 1961.

For the representation of the radial components of the wave functions of the Kepler problem those Laguerre polynomials or confluent hypergeometric series which transfer directly into nonrelativistic eigenfunctions

were used. The normalization of the wave functions of closed states was carried out, and the wave functions of the open state were indicated in the force-free case. Solutions were produced from a single component function by means of a matrix operator and plane waves were converted into 4 component spherical waves which are individual solutions of force-free wave equations. (Contractor's abstract)

2230

Oslo U. Inst. for Theoretical Physics (Norway).

[ON THE REPRESENTATION OF SPINORS] Uber die Darstellung von Spinoren, by E. A. Hylleraas. [1961] [7]p. incl. diagr. [(AF 61(052)134)] Unclassified

Published in Zeitschr. Phys. v. 167: 243-249, Mar. 1962.

The author constructs a 2 index 2 component spinor, a spinor matrix, by requiring that when it is written as a matrix, its columns be the proper vectors of a particular 2 index, two-component spinor. The spinor matrices are shown to be useful in the discussion of various physical problems including the derivation of the Klien-Nishino formula. (Math. Rev. abstract)

2231

Oslo U. Inst. of Chemistry (Norway).

DIRECT STRUCTURAL EVIDENCE FOR WEAK CHARGE-TRANSFER BONDS IN SOLIDS CONTAINING CHEMICALLY SATURATED MOLECULES, by O. Hassel and C. Rømming. [1962] [18]p. incl. diagrs. tables. (AFOSR-3637) (AF 61(052)71) Unclassified

Also published in Quart. Rev. v. 16: 1-18, 1962.

The empirical results obtained from structural investigations of solids, in which charge-transfer bonds are present linking together electron-donating molecules or parts of molecules and electron acceptors like halogen molecules or halide molecules, are reviewed. Fifty-four references are included.

2232

Oslo U. Inst. of Chemistry (Norway).

CRYSTAL STRUCTURES OF OXALYL BROMIDE AND OXALYL CHLORIDE, by P. Groth and O. Hassel. [1962] [7]p. incl. diagrs. tables. (AF 61(052)71) Unclassified

Published in Acta Chem. Scand., v. 16: 2311-2317, 1962.

Details are presented of crystal structure determinations of oxalyl bromide and oxalyl chloride. The crystals are not isomorphous and their structures quite different. In the oxalyl bromide structure weak charge transfer bonds connect every molecule with its 4 nearest neighbors, the O...Br separation (3.27A) being only slightly shorter than the expected van der Waals separation. The C-Br...C angle is found equal to 169°. In the oxalyl chloride structure, charge transfer bonds between oxygen and chlorine are not indicated.

2233

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] [9]p. (AFOSR-2030) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) AD 631916 Unclassified

Also published in Jour. Endocrinol., v. 22: 119-127, 1961.

For abstract see item no. 1963, Vol. IV.

2234

Oslo U. Neuropnysiological Lab. (Norway).

INCREASE IN SEX DRIVE BY SEPTAL, TEMPORAL CORTICAL AND HABENULAR LESIONS IN RATS, by E. W. Rasmussen, B. R. Kaada and others, [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-2740) [AF 61(514)1127] Unclassified

The effects of various neocortical and rhinencephalic lesions on the sex drive have been studied in 139 male and female rats. The animals were tested pre- and postoperatively in a modified obstruction box in which the number of crossings of an electrified grid to a sex incentive in 30 min period was regarded as an index of the strength of the sex drive. An increase in the number of crossings was produced in 28 rats of which 25 suffered bilateral lesions in the septal region, the temporal-insular cortex, and the stria medullaris and habenula. No change was produced by epiphysectomy. The increase was not due to a lowered sensitivity to the electrified grid, nor to loss of fear of crossing the grid, as evidenced by passive avoidance tests performed in the same animals and by the time taken to perform a certain number of crossings with no current on the grid. In the animals showing an increased number of crossings to a sex incentive postoperatively, there was a decrease in wheel-running, indicating that the increase in the number of crossings cannot be due to an increase in the general motor activity of the animal. It is suggested that the septum, stria medullaris, habenula and the temporal-insular cortex normally suppress the arousal mechanism in mating behavior and counterbalance the arousal effect exerted by the genital region of the sensorimotor cortex, the olfactory system and amygdala. (Contractor's abstract)

2235

Oslo U. [Neurophysiological Lab.] (Norway).

IMPAIRED ACQUISITION OF PASSIVE AVOIDANCE BEHAVIOR BY SUBCALLOSAL, SEPTAL, HYPOTHALAMIC, AND INSULAR LESIONS IN RATS, by B. R. Kaada, E. W. Rasmussen, and O. Kveim. [1961] [10]p. incl. illus. diagr. table, refs. (AFOSR-2742) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) AD 624011 Unclassified

Also published in Jour. Compar. and Physiol. Psychol., v. 55: 661-670, 1962.

The present results are based on the study of 191 brain lesioned rats and 24 normal control animals. The various lesions involve: a variety of cortical areas, the septal nuclei, hippocampus, fornix, corpus callosum, thalamic, preoptic, and anterior hypothalamic regions. A behavioral test measured the water-deprived animals' ability to passively avoid shock by not drinking from an electrified water source. The main conclusions are: (1) Passive avoidance behavior is deficient following bilateral lesions of subcallosalseptal-preoptic area, the anterior hypothalamus, and thalamus. (2) Bilateral neocortical lesions depress passive avoidance behavior when insular cortex is involved in the damage. (3) The behavioral effect of the lesions is interpreted as representing the animals' inability to inhibit the relevant approach response. The implicated areas have already been shown by stimulation to have somatomotor inhibitory functions. (4) Alternate explanations of the findings are considered and tentatively rejected.

2236

Oslo U. Neurophysiological Lab. (Norway).

DECREASE IN SEX DRIVE BY ABLATION OF THE SENSORIMOTOR CORTEX, AMYGDALA AND OLFACTORY BULBS IN RATS, by B. R. Kaada, E. W. Rasmussen and others. [1962] [22]p. incl. tables, refs. (AFOSR-2801) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities). Unclassified

Lesions were made in various cortical areas and 'rhinencephalic' structures of 139 male and female rats at the age of about 6 months. The animals were tested preoperatively in a modified obstruction box in which the number of crossings of an electrified grid to a sex incentive during a given period (30 min.) is used as an indication of the strength of the heterosexual drive. Retesting was performed 5 to 28 weeks after the operation. A group of 96 rats served as controls. The extent of the lesions was determined histologically. A marked decrease in the crossings produced by bilateral removal of (1) the upper part of the sensorimotor cortex, apparently corresponding to the genital representation, (2) the amygdala, and (3) the olfactory bulb, was not due to a decrease in the general motor activity nor increased sensitivity to the grid. The above could be counteracted by bilateral removal of the septum, habenula, or temporal-insular cortex. The estrous cycle and the copulatory behavior of the animals were retained. It is suggested that the removal of (1), (2), and (3) above interferes with the arousal mechanism in mating behavior.

2237

Oslo U. Neurophysiological Lab. (Norway).

THE LACK OF EFFECT OF LSD 25 ON AMYGDALOID AND CORTICAL ATTENTION RESPONSES, by H. Ursin. [1962] [14]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61 (514)1127 and Norwegian Research Council for Science and Humanities) Unclassified

Also published in Psychopharmocologia, v. 3: 317-330, 1962.

The present report deals mainly with the effects of LSD 25 on the threshold for the attention response elicited by stimulation of the cerebral cortex, the amygdaloid nuclear complex and the brain stem reticular formation. In addition, a few observations were made following stimulation of intralaminar thalamic nuclei, caudate nucleus and septal area. The threshold of the attention responses was tested before and after intravenous or intraperitoneal injection of LSD 25. The threshold was found to be unaltered by the drug for all central nervous system structures studied. Since there was no effect of LSD 25 on the telencephalically induced attention response while chlorpromazine has a clear blocking effect under the same experimental circumstances, it seems no longer correct to consider these 2 psychotropic drugs as having any simple opposite effect on nervous system function. The results are believed to have some bearing upon the possibility that the main effect of LSD 25 is due to interference with sensory inflow to the central nervous system.

2238

Oslo U. Neurophysiological Lab. (Norway).

RESEARCH ON FUNCTIONAL SIGNIFICANCE OF 'LIMBIC' AND RELATED STRUCTURES IN THE BRAIN, by B. [R.] Kaada. Final technical rept. Feb. 1, 1961-Jan. 31, 1962, 15p. incl. refs. (AF 61(514) 1127) AD 631917 Unclassified

Studies on the following topics were made: (1) telencephalic (cortical and amygdaloid) attention or arousal mechanism and emotion. (2) rats with lesions in limbic and related structures, and (3) electrophysiology of the hippocampus.

2239

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL GROWTH ON C_1 COMPOUNDS. 4. CARBOXYLATION OF PHOSPHOENOLPYRUVATE IN METHANOL-GROWN PSEUDOMONAS AM1, by P. J. Large, D. Peel, and J. R. Quayle. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-4292) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service, and Rockefeller Foundation) AD 632033 Unclassified

Also published in Biochem Jour., v. 85: 243-250, Oct. 1962.

Cell-free extracts of MeOH-grown Pseudomonas AM 1 were examined for the presence of enzymes catalyzing the carboxylation of pyruvate or phosphoenolpyruvate (I) to C_4-dicarboxylic acids. The only enzyme found in appreciable activity was a I carboxylase, similar to that found in plant tissues. The enzyme has been purified 28-fold by protamine sulfate treatment, $(NH_4)_2SO_4$ precipitation, and diethylaminoethyl cellulose column chromatography. The purified I carboxylase catalyzes the formation of oxalacetate and inorganic phosphate from I and HCO_3^-. The reaction is Mg^{++} dependent, with a pH optimum of 8.5. It is competitively inhibited by phosphate and noncompetitively by NH_4^+. K_m values of 0.33 mM and 0.196 mM, respectively were found for I and $MgCl_2$ at pH 8.5 and 22°. The properties of the enzyme were compared with those of similar enzymes obtained from other sources.

2240

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_1- COMPOUNDS AND OXALIC ACID IN MICRO-ORGANISMS, by H. Krebs and J. R. Quale. Final technical rept. Sept. 1, 1961-Aug. 31, 1962. Sept. 31, 1962, 19p. incl. tables, refs. (AFOSR-4337) (AF 61(052)180) AD 293150 Unclassified

Activities of enzymes implicated in a scheme of biosynthesis of cell constituents from Cl growth substrates have been measured in Pseudomonas AM1 grown on methanol, formate and succinate, and the values compared. A phosphoenolpyruvate carboxylase from this organism has been purified and its properties studied. Attempts have been made to isolate glycine-serine- orglyoxylate- requiring mutants of Pseudomonas AM1. Oxalyl coenzyme A has been synthesized and its properties examined. Contributions of heterotrophic and autotrophic growth of Pseudomonas oxalaticus on oxalate are being measured.

2241

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_2-COMPOUNDS IN MICRO-ORGANISMS. 9. ROLE OF THE GLYOXYLATE CYCLE IN PROTOZOAL GLYCONEOGENESIS, by J. F. Hogg and H. L. Kornberg. [1962] [8]p. incl. illus. tables, refs. (AFOSR-J469) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Horace H. Rackham School of Graduate Studies, and National Science Foundation) AD 407101 Unclassified

Also published in Biochem. Jour., v. 86: 462-468, March 1963.

Tetrahymena pyriformis, strain E, cells grown in proteose-peptone media contained malate synthase in high activity but they were low in isocitric lyase. The formation of malic synthase was repressed by glucose; this repression was partially relieved by acetate. The formation of isocitric lyase was stimulated by acetate in the presence or in the absence of glucose. Cells grown in chemistry defined media containing acetate contained both isocitric lyase and malic synthase in high activity; cells grown in such media containing glucose were virtually devoid of both enzymes. These findings show that isocitric lyase and malic synthase, though operationally linked in the glyoxylate cycle, are not coordinately repressible. Tetrahymena capable of converting fats into glycogen contained both enzymes in higher activity than those incapable of glyconeogenesis. In the former type of organism, the enzymes were found only in 1 of the 2 mitochondrial fractions obtained after disruption of the cells; in the latter type, the enzymes were not localized in any single cellular component. These results suggest that the conversion of fat into glycogen by Tetrahymena necessitates both the presence of high activities of glyoxylate-cycle enzymes and their incorporation into an organized intracellular structure.

2242

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL GROWTH ON C_1 COMPOUNDS. 5. ENZYME ACTIVITIES IN EXTRACTS OF PSEUDOMONAS AM 1, by P. J. Large and J. R. Quayle. [1962] [11]p. incl. diagrs. tables, refs. (AFOSR-J955) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service and Rockefeller Foundation) AD 416577 Unclassified

Also published in Biochem. Jour., v. 87: 386-396, May 1963.

The following enzymes were found in extracts of MeOH-, formate-, and succinate-grown Pseudomonas AM1 and their activities measured: tetrahydrofolate

formylase, methylene-tetrahydrofolate dehydrogenase, serine hydroxymethyltransferase, glycerate dehydrogenase, glyoxylate reductase, malate synthase, citrate synthase, isocitrate dehydrogenase, and malate dehydrogenase. No glyoxylate carboligase, isocitrate lyase, or malate dehydrogenase (decarboxylating) could be detected in the organism grown on any of the substrates. Transamination of serine with α-oxoglutarate and pyruvate was observed in extracts of Pseudomonas AM1. Cell-free extracts of Pseudomonas AM1, fortified with suitable cofactors, catalyze the conversion of formate to glycine and give serine and glycerate as major products. In the presence of adenosine triphosphate the extracts catalyze the phosphorylation of glycerate to phosphoglycerate. (Contractor's abstract)

2243

Oxford U. Dept. of Biochemistry (Gt. Brit.).

CARBON ASSIMILATION BY PSEUDOMONAS OXALATICUS (OX 1). 6. REACTIONS OF OXALYL-COENZYME A, by J. R. Quayle. [1962] [6]p. incl. diagrs. table, refs. (AFOSR-J956) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service, and Rockefeller Foundation) AD 416606 Unclassified

Also published in Biochem. Jour., v. 87: 368-373, May 1963.

It is shown that oxalyl-CoA maybe readily synthesized and some of its chemical properties are described. Its reversible enzymic reduction to glyoxylate and CoA has been demonstrated. This reaction has been suggested as a key reaction in the microbial synthesis of cell constituents from oxalate. Use of the measured equilibrium constant gives a value of + 2·54 kcal for $\Delta G'$ at pH 7·0 of reaction (2), proceeding from left to right. This compares with the value -0·9 kcal calculated from thermodynamic data. However, some of the values used in the latter calculation, e.g. the heat of combustion of oxalic acid and the free energy of hydrolysis of oxalyl-CoA, are of doubtful accuracy. The value of + 2·54 kcal for the free energy of reduction of oxalyl-CoA may be compared with the value of + 4·2 kcal for the analogous reaction (3) catalysed by the aldehyde dehydrogenase from Clostridium kluyveri $CH_3 \cdot CO \cdot S \cdot CoA + NADH + H^+ \rightleftharpoons CH_3 \cdot CHO + NAD^+ + CoA \cdot SH$.

2244

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

RESEARCH IN THE NEURAL MECHANISMS UNDERLYING PERCEPTION, by D. M. Vowles. [Final rept.] June 11, 1962, 17p. (Technical rept. no. 1) (AFOSR-3040) (In cooperation with Reading U., Oxford (Gt. Brit.)) (AF 61(052)420 and AF 61(052)114) AD 288422 Unclassified

The object of the research reported was to investigate the way in which patterns of stimuli become transformed in the insect nervous system to form patterns of responses. This was investigated in locusts, bees, and ants, using behavioral, neurosurgical and electrophysiological methods.

2245

[Oxford U. Dept. of Biochemistry] (Gt. Brit.).

EXPERIMENTS ON VISUALLY CONTROLLED ORIENTATION IN THE DESERT LOCUST, SCHISTOCERCA GREGARIA (FORSKAL), by G. K. Wallace. [1962] [9]p. incl. diagrs. tables, refs. (In cooperation with Reading U. Oxford (Gt. Brit.)) (AF 61(052)114 and AF 61(052) 420)) Unclassified

Published in Animal Behav., v. 10: 361-369, July-Oct. 1962.

This paper raises the problem of the mechanisms underlying visually controlled orientation in the Desert Locust. The experiments are concerned with 3 aspects of this problem: (1) inhibition of information from, or response to, irrelevant stimuli, (2) the processes of orientation to one of several possible stimuli; and (3) the maintenance of direction once locomotion is initiated. Lack of response to irrelevant stimuli appears to be due to a mutual exclusion of responses at the motor level. There is no evidence of centrifugal sensory inhibition. The behavior observed while the insect becomes orientated to 1 of 2 stimuli is described and an explanation given in terms of varying thresholds for the release of jumping and turning responses. A tracking experiment is described which shows that direction of locomotion is not maintained under certain circumstances. The experimental results are embodied in a tentative description of the processes underlying orientation.

2246

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

THE SODIUM CONTENT OF THE SMOOTH MUSCLE OF THE GUINEA PIG TAENIA COLI, by P. J. Goodford. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-J302) (AF 61(052)476) AD 408044 Unclassified

Also published in Jour. Physiol., v. 163: 411-422, Oct. 1962.

The sodium, potassium and lithium contents of the smooth muscle of the guinea-pig taenia coli have been determined after immersion in sodium-free solutions prepared with lithium chloride, chlorine chloride or tris-hydroxymethylaminomethane hydrochloride. More sodium was lost rapidly from the muscle than could be accounted for by the material in the extracellular space. But 1.5 mmol/kg wet wt at 35°C and 50 mmol/kg wet wt at 4°C remained firmly in the tissue during

immersions in sodium-free solution lasting 1 hr. The observations indicated that the muscle sodium was not simply distributed between the intracellular and extracellular spaces. The results are discussed with reference to the known ability of smooth muscle to generate action potentials in sodium-free solutions. (Contractor's abstract)

2247

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

SODIUM AND POTASSIUM CONTENT OF THE SMOOTH MUSCLE OF THE GUINEA-PIG TAENIA COLI AT DIFFERENT TEMPERATURES AND TENSIONS, by M. Freeman-Narrod and P. J. Goodford. [1962] [13]p. incl. illus. diagrs. refs. (AFOSR-J302) (AF 61(052)476) AD 408046 Unclassified

Also published in Jour. Physiol., v. 163: 399-410, Oct. 1962.

The total sodium and potassium content of the guinea-pig taenia coli, and the rate of uptake of radioactive sodium and potassium ions, have been measured in vitro at 35°, 20° and 4°C and at a range of tensions. The average cell diameter was also measured at each tension. The total potassium content was reduced, and the total sodium increased at lower temperatures. The rate of uptake of tracer ions was depressed by cooling. At 4°C both sodium and potassium were partly inexchangeable. At 20°C the sodium was partly inexchangeable. At 35°C all the sodium exchanged very rapidly, which may indicate that this exhcange is an "active" process. Tension changes did not affect the total sodium or potassium content. The rate of uptake of tracer potassium was increased at higher tensions, and the rate of sodium loss was reduced when no tension was applied to the muscle. These effects might be due to the increased ratio of cell surface area to cell volume, and for potassium they were quantitatively explained in this way. (Contractors abstract)

2248

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

LACK OF ACTIVATION OF PHOSPHORYLASE BY ADRENALINE DURING ITS PHYSIOLOGICAL EFFECT ON INTESTINAL SMOOTH MUSCLE, by E. Bueding, E. Bulbring and others. [1962] [3]p. incl. refs. (AFOSR-J304) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)476, American Heart Association, Office of Naval Research, and Public Health Service) AD 408045 Unclassified

Also published in Nature, v. 196: 944-946, Dec. 8, 1962.

Adrenaline causes no activation of phosphorylase in the intact tissue at the time when it produces relaxation of intestinal smooth muscle by causing cessation of spike activity and hyperpolarization. Phosphorylase activity may be increased afterwards by subjecting the tissue to certain manipulations, and this activation is greater after previous treatment with adrenaline. No activation is demonstrable with an improved technique. Since the changes in the electrophysiological and mechanical state of taenia coli produced by adrenaline require metabolic energy, it appears that biochemical mechanisms other than activation of phosphorylase or of phosphofructokinase must be associated with these [illegible] (Contractor's abstract)

2249

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

INFLUENCE OF SODIUM AND CALCIUM ON SPONTANEOUS SPIKE GENERATION IN SMOOTH MUSCLE (Abstract), by E. Bülbring, H. Kuriyama, and B. Twarog. [1962] [2]p. (AFOSR-J310) (AF 61(052)476) AD 408052 Unclassified

Presented at meeting of the Physiol. Soc., London (Gt. Brit.), Jan. 13, 1962.

Also published in Jour. Physiol., v. 161: 48P-49P Apr.-May 1962.

Experiments were performed on intestinal smooth muscle of the guinea-pig taenia coli using the sucrose gap method and intracellular electrical recording. If the calcium is removed from the bathing solution, the excitation, commonly observed in other excitable tissues, may be absent or short lasting and soon the spontaneous spike discharge ceases. Conversely, if the external calcium concentration is raised to 7.5 mM, a period of increased electrical activity usually precedes the membrane stabilization. Spontaneous spike discharge continues when sodium is substituted by lithium, and also with tris-(hydroxymethyl)amino methane) for periods up to 1 hr. The amplitude of the spontaneously discharged action potentials is not reduced by reducing the external sodium concentration and replacing it with Tris. However, the local potentials (slow waves) are abolished in the absence of sodium and are greatly increased in excess sodium. If calcium is removed from a sodium-free Tris solution electrical activity stops in a few minutes, and starts again when calcium is restored. The time during which spontaneous spike discharge continues in sodium-free solution becomes shorter when the external calcium is reduced below half the normal concentration; e.g. in 1.3 mM Ca^{2+} it stops after 28 min, in 0.6 mM after 15 min, in 0.3 mM after 8 min. The amplitude of the spontaneously discharged action potential in sodium-free solution appears to be a function of the external calcium concentration. In the presence of excess calcium, the spikes are followed by a positive after-potential which, on passing off, continues as a potential initiating the next spike, thus producing a pace-maker type of action potential. The observations suggest that calcium may be essential for spike discharge in this smooth muscle.

2250

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

THE IMPORTANCE OF CALCIUM FOR MEMBRANE POLARIZATION AND SPONTANEOUS ACTIVITY OF INTESTINAL SMOOTH MUSCLE CELLS (GUINEA-PIG TAENIA COLI) (Abstract), by E. Bülbring and H. Kuriyama. [1962] [1]p. [AF EOAR-62-5] Unclassified

Published in Proc. Internat'l. Union of Physiological Sciences: Twenty-second Internat'l. Cong. Leyden (Netherlands) Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 2: Abstract no. 866, 1962.

In excess calcium (7.5 mM) the maximum slope of the relation between membrane potential and external potassium concentration (K_0) is steeper (43 mV/tenfold K_0) than normal (38 mV/tenfold K_0) and for low K_0 more linear, indicating a dimminished Na-permeability in excess Ca. Removal of glucose depolarizes the membrane and accelerates spontaneous activity. Excess calcium initially prevents this, but not after prolonged glucose depletion, suggesting energy requirement for calcium function at the membrane. Spontaneous activity normally consists of local potentials and spikes. Excess calcium reduces the local potentials, especially when they are large and prolonged in excess Na; excess Ca then accelerates repolarization and spikes are followed by a positive after potential. Membrane activity continues in complete absence of Na (replaced with Tris), but stops rapidly in Na-free and Ca-free solution. Restoration of the normal Ca concentration restores activity. In the absence of Na, in normal solution, in low K_0 (0.3-3 mM), as well as in excess K_0(18 mM), i.e. regardless whether the membrane potential is high or low, the amplitude of the action potential decreases with a decrease of Ca_0 from 1.25 mM to 0.25 mM, and increases in the presence of 7.5 mM Ca_0. This result suggests that the presence of calcium is essential.

2251

Oxford U. Dept. of Nuclear Physics (Gt. Brit.).

THE DECAY OF K-MESIC ATOMS, by J. R. Rook. [1962] [27]p. incl. diagrs. tables, refs. (AFOSR-J364) (AF 61(052)455) AD 408599 Unclassified

Also published in Nuclear Phys., v. 39: 479-505, Dec. 1962.

The information concerning the form of the nuclear density distribution in the extreme surface region that would be obtained from measurements of the K-mesic x-ray yields is discussed. Certain extreme shapes would be distinguished from the conventional Saxon-Woods form, but there is not as much sensitivity to the form of the density distribution as might be expected. Reasons are given for this lack of sensitivity. The significance of the relatively large number of multinucleon events observed in nuclear emulsion is discussed. The discrepancy between the deuterium and emulsion data is first established and then the probability for the 2 step process is calculated. It is concluded that this process does not explain the frequency of multinucleon events observed in nuclear emulsion and it appears that there is some support for the hypothesis of strong correlations in the nuclear surface. (Contractors abstract)

2252

Oxford U. Dept. of Pharmacology (Gt. Brit.).

STUDY OF BIOCHEMISTRY OF BIOGENIC AMINES, by H. Blaschko. Final rept. July 1, 1959-June 30, 1962. July 10, 1962. 2p. (AFOSR-3032) (AF 61(052)235) AD 290198 Unclassified

This work led to the formulation of rules governing the substrate specificity of the amino acid decarboxylase that is responsible for the formation of the catechol amines in the body. It was shown that the presence of the hydrogen atom in position alpha is not essential for decarboxylation. The main outcome is the discovery of the strong awakening action of L-metatyrosine in the reserpinized animal, which is of practical interest, as the meta-hydroxy compound has much better keeping qualities than dopa and other catechol derivatives.

2253

Oxford U. Dept. of Pharmacology (Gt. Brit.).

OBSERVATIONS ON THE ENZYMIC OXIDATION OF ω-AMINO ACIDS, by H. Blaschko, S. M. Kirpekar, and S. D. Phipps. [1962] [3]p. incl. table. (AFOSR-4275) (AF 61(052)235) Unclassified

Also published in Arch. Internat'l. Pharmacodyn., v. 139: 120-122, 1962.

The ω-amino acids have become of interest since some members of the homologous series, $H_2N(CH_2)_nCOOH$, act on certain excitable structures. Experiments using the available commercial samples of 3 members of the series, ω-amino enanthic acid (or ω-amino-n-heptanoic acid), ω-amino caprylic acid (or ω-amino-n-octanoic acid) and ω-amino-n-hendecanoic acid, were carried out in an atmosphere of O_2 at 37.5°C. It is concluded that all 3 oxidases agree in that the presence of a second amino group in the close vicinity of the first interferes with the attachment of the latter for the enzyme. This interference becomes less when the second group is further removed; hence the long-chain diamines react with the enzymes and are oxidized. These observations show that the amino group is not unique in exerting a disturbing effect. The carboxyl group obviously does the same, here again the disturbing influence depends on the intramolecular distance. In the plasma oxidases, it appears that in the goat enzyme this effect wanes with shorter distances than in the

pig enzyme, but more experiments would be required to establish this difference with certainty.

2254

Oxford U. Dept. of Pharmacology, (Gt. Brit.).

THE AMINE OXIDASES OF MAMMALIAN BLOOD PLASMA, by H. Blaschko. [1962] [50]p. incl. diagrs. tables, refs. [AF 61(052)235] Unclassified

Published in Advances in Compar. Physiol. and Biochem., v. 1: 67-116, 1962.

Variation in the substrate specificity of an enzyme from species to species is a phenomenon frequently encountered. Differences of this kind are believed to be due to variations in the enzyme protein, probably in the amino acid composition; they may also manifest themselves in immunological differences that occur when specimens of an enzyme are prepared from different species. The differences found among the amine oxidases of mammalian blood plasma from different species are therefore by no means unique. What is unusual and interesting is that here are variations in the substrate specificity pattern of a more fundamental type. The significance of these variations and their bearing on the question of the relationship between mammalian species are discussed in this review.

2255

Oxford U. Dept. of Pharmacology (Gt. Brit.).

BIOLOGICAL INACTIVATION BY AMINE OXIDASES AND TIME COURSES OF DRUG ACTION, by H. Blaschko. [1962] [6]p. incl. refs. (AFOSR-J174) Sponsored jointly by Agricultural Research Council, Air Force Office of Scientific Research under AF EOAR-62-80, and Public Health Service) AD 400428 Unclassified

Also published in Proc. First Internat'l. Pharmacological Meeting, Stockholm (Sweden) (Aug. 22-25, 1962), Oxford, Pergamon Press, v. 6: 289-293, 1962.

New work shows clearly that the current classification of amine oxidases is obsolete. The histaminase of pig kidney is a diamine oxidase, as first shown by the work of Zeller and strongly supported by subsequent observations; the histaminase of pig plasma is a monoamine oxidase. Both of these enzymes, are inhibited by cyanide and by carbonyl reagents (semicarbazide, hydroxylamine and aminoguanidine). The pig plasma oxidase shares many substrates with the intracellular monoamine oxidase, and yet, the latter is not inhibited by cyanide nor by carbonyl reagents. There is also the pea seedling oxidase, an enzyme sensitive to both cyanide and carbonyl reagents, which will act on diamines as readily as on monoamines. Thus, inhibition by carbonyl reagents is common to all these enzymes, with the single exception of the well-known intracellular monoamine oxidase. The action of these reagents is probably on a carbonyl group in the 2 amino hydrogens of the substrate, $R\text{-}CH_2\text{-}NH_2$, to form a Schiff's base, $\rangle C = N.CH_2.R$ as an intermediate. This is supported by the observation that the plasma oxidases are unable to act on N-methylated amines, in sharp contrast to the intracellular aminoxidase, which oxidizes the N-methylated amines (e.g. adrenaline or metanephrine) as readily as the corresponding primary amines. On the other hand the intracellular histaminase resembles the plasma oxidases in the inability to act on N-methylated amines. These observations suggest that the primary enzyme-substrate complex formed by the intracellular amine oxidase is fundamentally different; it probably involves an immediate reaction with at least one of the hydrogen atoms attached to the α-carbon atom.

2256

Oxford U. Dept. of Pharmacology (Gt. Brit.)

POTENTIATION OF THE RESPONSE TO HISTAMINE BY PICOLYLAMINES, by H. Blaschko and S. Kurzepa. [1962] [8]p. incl. diagrs. (AFOSR-J176) (AF EOAR-62-80) AD 400429 Unclassified

Also published in British Jour. Pharmacol. and Chemother., v. 19: 544-551, Dec. 1962.

The response of the isolated ileum of the guinea pig to histamine is potentiated in the presence of 2-, 3-, or 4-picolylamine. These compounds have been found to inhibit the histaminase and (or) diamine oxidase of pig kidney. The 3 corresponding picolylmethylamines did not potentiate the response of the ileum to histamine; they were without significant affinity for the pig kidney oxidase. It is suggested that the potentiating action of the 3 primary amines is due to their inhibitory action on histaminase. The responses of the ileum to acetylcholine and 5- hydroxytryptamine were not potentiated. (Contractor's abstract)

2257

Oxford U. Engineering. (Gt. Brit.).

SELF CONSISTENT COMPUTATION OF AN R.F. CONFINED PLASMA CONFIGURATION, by H. Motz. [1962] 17p. incl. diagrs. tables. (Technical note no. 10) (AFOSR-2694) (AF 61(514)1183) AD 289196 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., v. 2: 1484-1494, 1962. (Title varies)

The confinement of a plasma by an electromagnetic field oscillating at a frequency above the plasma frequency in a resonator was studied. The resonator,

a cylindrical cavity, supported an E_{011} mode of oscillation and the dimensions were chosen specially to lead to a field configuration such that, in the absence of plasma, it had a field minimum surrounded everywhere by higher field values. A self-consistent calculation was carried out in order to find a stable plasma configuration confined by the field. The perturbation of the cavity resonance by the plasma was determined. The calculation was done numerically by means of a high-speed electronic computer.

2258

Oxford U. Engineering Lab. (Gt. Brit.).

FREQUENCY DOUBLING WITH FERRITES, by C. S. Gaskell. [1962] [15]p. incl. diagrs. (Technical note no. 12) (AFOSR-2695) (AF 61(514)1183) AD 289197 Unclassified

Previous measurements on millimeter wave harmonic generation in ferrites have shown that powers of about 20 w can be produced at 2 mm wavelength (with unspecified conversion losses). As conversion losses as low as 3.5 db have been reported at lower frequencies, the method appears attractive for doubling from 35 gc/s band; this being the highest frequency band at which high power reliable tubes are generally available. Measurements have been made on a variety of ferrites, the best results for frequency doubling being obtained with Ferroxcube D5 in a disk geometry. Peak output powers up to 600 at 70 gs/s have been measured with conversion losses of 14 db. Maximum output power power was obtained when the output waveguide was polarized parallel to the input guide, rather than perpendicular. Preliminary measurements on higher harmonics indicate that the third is at least 60 db down on the fundamental. Possible explanations for the discrepancies between these measurements and the simple theory are presented, together with suggestions for improved techniques, and further applications of ferrite doubling. (Contractor's abstract)

2259

[Oxford U. Engineering Lab. (Gt. Brit.)]

[MILLIMETER WAVE AND SUB-MILLIMETER WAVE RESEARCH], by H. Motz. Final rept. Mar. 1, 1957-Feb. 28, 1962. Mar. 21, 1962, 6p. incl. refs. (AFOSR-2696) (AF 61(514)1183) AD280984 Unclassified

The work under this contract was mostly concerned with the exploration of the undulator principle for the generation of submillimeter waves. Other methods for generating such waves were also studied. The aim of the work on millimeter and submillimeter waves is the study of hot plasma. Wave propagation in a plasma was studied theoretically.

2260

Oxford U. Engineering Lab. (Gt. Brit.).

GENERATION AND USE OF PULSED MAGNETIC FIELDS, by C. S. Gaskell. 1962, [36]p. incl. illus. diagrs. tables, refs. (Technical note No. 11) (AFOSR 2931) (AF 61(514)1183) AD 277626 Unclassified

Methods of generating high magnetic fields are surveyed, and the design and construction of a pulsed field set are described. Capacitors are used to store the energy, and are discharged through a triggered spark gap into a special wire-wound solenoid. By this method, fields up to 280 kilogauss have been produced. A method of plotting magnetization curves in high fields is described, and results are given for gadolinium. Sources of error and possible improvements in the experimental technique are discussed. (Contractors abstract)

2261

Oxford U. [Engineering Lab.] (Gt. Brit.).

MILLIMETER WAVE HARMONIC GENERATION IN FERRITES, by C. S. Gaskell. [1961] [3]p. incl. diagrs. [AF 61(514)1183] Unclassified

Published in Proc. Inst. Radio Engineers, v. 50: 326, Mar. 1962.

An output (harmonic) waveguide was polarized perpendicular and parallel to the input guide. The low outputs obtained with perpendicular polarization are believed to be due to the large mis-match of the sample. Much better matching was obtained with parallel polarization. The reduction in efficiency at high input powers with the latter was caused by sample heating. The conversion losses for average power are some 3 db greater than for peak power, since the output pulse was only 80 nsec wide, compared with 170 nsec for the input pulse. This could have been caused by a frequency change during the magnetron pulse, or by spin wave excitation. With an input of 15 kw in the parallel geometry and with the Ferroxcube D5 sample, the third harmonic output was some 60 db below the input. Under certain conditions the magnetron was known to have given third harmonic outputs of this magnitude; this result is therefore not conclusive, but represents an upper limit. No higher harmonics were within the detection sensitivity of the apparatus (about -80 db).

2262

Oxford U. Engineering Lab. (Gt. Brit.).

DIELECTRIC PROPERTIES OF TITANIA CERAMICS AT MICROWAVE FREQUENCIES, by J. M. Free, M. E. B. Moffat, and G. B. Walker. [1962] [3]p. incl. diagrs. (AFOSR-J880) (Sponsored jointly by the Admiralty, Air Force Office of Scientific Research under AF EOAR-62-62, Defense Board of Canada,

Department of Scientific and Industrial Research, and Paul Fund of the Royal Society) AD 416019 Unclassified

Also published in Brit. Jour. Appl. Phys., v. 14: 289-291, May 1963.

The determination of the relative permittivity k and the loss tangent tan δ of the ceramics titania ($k \simeq 95$, $\tan \delta \simeq 0.0004$) and magnesium titanate ($k \simeq 14.3$, $\tan \delta \simeq 0.0001$) by H_{01} mode and 'ghost' mode cavity techniques is outlined. Results are presented for the frequency range 3 to 35 Gc/s at room temperature. It is noted that k varies by 5% in both materials, and that tan δ rises significantly but remains at a relatively low value as the frequency is raised from 3 to 35 Gc/s. Experiments are described in which 1.8 cm wavelength cavities loaded with single glazed titania disks have been successfully operated at electric field strengths up to 10mv m^{-1} with 20 kev axial electron beams. The use of these materials in slow-wave structures is briefly discussed. (Contractor's abstract)

2263

Oxford U. [Engineering Lab.] (Gt. Brit.).

NOTE ON THE ONE-DIMENSIONAL THEORY OF RADIO-FREQUENCY PLASMA CONFINEMENT, by H. Motz. [1962] [3]p. incl. diagr. (AFOSR-J881) (In cooperation with New York U., N. Y.) AF EOAR-62-62) AD 416038 Unclassified

Also published in Phys. Fluids, v. 6: 308-310, Feb. 1963.

A 1-dimensional theory of radio-frequency plasma confinement above the critical density is studied. It is concluded that confinement is not strictly speaking, possible, but that a solution representing partial confinement exists and may be acceptable practically.

2264

Oxford U. Engineering Lab. (Gt. Brit.).

PRODUCTION OF A HIGHLY BUNCHED ELECTRON-BEAM FOR A SUBMILLIMETER WAVE UNDULATOR, by A. J. Lichtenberg, M. E. B. Moffat, and H. Motz. [1962] [4]p. incl. diagrs. [AF EOAR-62-62] Unclassified

Published in Microwave: Proc. Fourth Internat'l. Conf. on Microwaves Tubes, Scheveningen (Netherlands) (Sept. 3-7, 1962), Eindhoven, Centrex Publishing Co. 1963, 375-378.

In order to generate sub-millimeter waves in a magnetic undulator more efficiently than has been possible before, an electron linac has been proposed which will provide a 2-mev beam of tightly bunched electrons for injection into the undulator. It was shown by Walsh and Motz that an undulator output of the order of watts can be achieved in practice in a wavelength region for which the beam bunching is adequate. It is hoped that the accelerator under construction will provide such a power at half a millimeter. The bunching action packs the electrons into a certain fraction of the length of the period of the wave on which they are riding. It is clear that the shortest accelerator wavelength possible should be chosen for close bunching. From practical consideration of availability of power sources, size of structure, machining tolerances and beam diameter, 1.8823 cm was chosen as the working wavelength of the linac. The design of an accelerator for optimum bunching has been considered in a theoretical investigation using as the principal tool the theorem of adiabatic invariance of the integral $\oint p' \, dz' =$ constant extended over a period of the motion. The variables p' and z' are the longitudinal momentum and distance coordinates measured relative to those of the phase-stable particle S of velocity v_s riding at a position with phase ϕ_s of a wave of peak axial electric field ϵ traveling with velocity v_s.

2265

Oxford U. Inorganic Chemistry Lab. (Gt. Brit.).

THE REACTION OF ATOMS AND RADICALS WITH VARIOUS MOLECULES AND WITH ONE-ANOTHER, by J. W. Linnett. [Final rept.] Oct. 29, 1962, 15p. (AFOSR-4060) (AF EOAR-62-6) AD 290631 Unclassified

This report covers the recombination of oxygen atoms in the gas phase, recombination of atoms at oxide surfaces, attack of metals by atoms, recombination of atoms on Pd:Au alloys, as well as new methods for studying recombination coefficients

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.

2266

Paris U. (France).

DYNAMICAL THEORY OF THE REFLECTION OF X-RAYS BY NON-PERFECT CRYSTALS, by D. Taupin. Final technical rept. Mar. 31, 1962, 49p. incl. diagrs. refs. (AFOSR-2963, pt. 1) (AF 61-(052)310) AD 289109 Unclassified

A generalization of Zachariasen's dynamical theory is derived for the case of distorted or non-perfect crystals and non-plane waves; this treatment does not separate the wavefields in the crystal medium and leads to a partial differential equation system which can only be numerically solved. A detailed application to bent and uniformly distorted crystals is given, which is a generalization of our former dynamical theory. A rough calculation of dislocation cross sections for the Bragg Case is then reported. Some figures are given, which indicate the range of utility of the x-ray method for the determination of the perfection of silicon crystals. Experimental measurements of reflecting powers of imperfect silicon crystals have been made. The agreement with calculated values is rather satisfactory. (Contractor's abstract)

2267

Paris U. (France).

CRYSTALLINE TEXTURE OF $BaTiO_3$ CRYSTALS, by C. Bousquet, M. Lambert and others. Final technical rept. Mar. 31, 1962, 29p. incl. illus. diagrs. (AFOSR-2963, pt. 2) (AF 61(052)310) AD 278109 Unclassified

This report on the measurement of parameters and disorientations in a multidomain $BaTiO_3$ crystal draws a correlation between the square pattern texture and a quasi-cubic phase. The barium titanate may exist at room temperature under a crystalline form clearly different from the normal tetragonal form; it is very slightly tetragonal, and the observed axial ratio varies with the sample. Many details of the deformation of the crystallites in this texture have been accurately determined. Nevertheless many questions are left unanswered: for instance the arrangements of the domains in the square pattern texture and the mechanism of formation of this texture. The results show that it is necessary to specify the structure and the texture of a sample for a fundamental study of its ferroelectric properties. It is very likely that these properties are dependent on the variation of the axial ratio of the crystal, which varies with the sample.

2268

Paris U. (France).

RAREFIED GAS DYNAMICS: PROCEEDINGS OF THE THIRD INTERNATIONAL SYMPOSIUM, Paris (France) (June 1962), ed. by J. A. Laurman. New York, Academic Press, 1963, 2v. incl. illus. diagrs. tables, refs. (AFOSR-5312) (Sponsored jointly by Air Force Office of Scientific Research under MIPR-62-7, Délégation Générale a la Recherche Scientifique et Technique, International Union of Theoretical and Applied Mechanics, National Aeronautics and Space Administration, and Office of Naval Research) Unclassified

Various aspects of rarefied gas dynamics are considered including fundamental kinetic theory, molecular beams and surface interactions, ionized flows, transition flow, theory and experiment, and experimental methods. Included in the first section are a number of papers discussing the validity of the Boltzmann equation as applied in rarefied gas dynamics (including the ionized case) and various techniques for solving it. Other papers in this section consider more specific problems such as shock wave structure. In addition to a number of papers dealing with standard molecular beam techniques, Section II also presents newer methods including the nozzle-source method for producing beams. Section III is concerned with the application of free molecule flow theory to ionized gas flows. Various attempts, theoretical and experimental, to bridge the gap in knowledge between continuum and free-molecule flows are covered in Sections IV and V. The last section contains a few papers involving experimental methods related to testing with both ionized and unionized gases in low density wind tunnels. Also included are a selected number of questions and answers that followed in the discussion period after each presentation.

2269

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

STRONG INTERACTION SYMMETRIES AND RELATIONS BETWEEN POLARIZATIONS FOR $\bar{p}p \to \bar{Y}Y$, by E. de Rafael. [1962] [32]p. incl. tables. (Technical note no. 3) (AFOSR-2326) (AF 61(052)474) AD 293163 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 321-336, July 1962.

The consequences of different symmetry groups for strong interactions are studied in terms of reactions between polarizations. Some experimental tests concerning antihyperon - hyperon production by means of $\bar{p}p$ and $\bar{p}d$ annihilations are proposed. (Contractor's abstract)

2270

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

$\Sigma^\circ - \Lambda^\circ$ RELATIVE PARITY FROM $\Lambda^\circ \to \Sigma^\circ$

CONVERSION INDUCED BY THE COULOMB FIELD OF A NUCLEUS, by E. de Rafael. Mar. 15, 1962, 17p. incl. diagr. tables. (Technical note no. 4) (AFOSR-2528) (AF 61(052)474) AD 280023 Unclassified

Also published in Phys. Rev., v. 128: 2435-2439, Dec. 1, 1962.

J. Dreitlein and H. Primakoff have recently proposed use of the $\Lambda^\circ - \Sigma^\circ$ conversion induced by the Coulomb field of nuclei to determine the Σ° lifetime. It is shown here that the same experiment could also be used to measure the $\Sigma^\circ - \Lambda^\circ$ relative parity. Indeed, as a good approximation, the transversal polarizations (in the laboratory system) of the Λ° and Σ° particles are equal or opposite according to a respectively even or odd $\Sigma^\circ - \Lambda^\circ$ relative parity. (Contractor's abstract)

2271

[Paris U. Lab. de Physique Théorique et Hautes Energies (France).]

WEAK-ELECTROMAGNETIC AND PIONIC DECAY OF HYPERONS, by J. Nuyts. Apr. 1, 1962, 16p. incl. tables, refs. (Technical note no. 5) (AFOSR-2933) (AF 61(052)474) AD 277627 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 374-384, July 16, 1962.

Using the pole approximation for the weak-electromagnetic and pion decays of hyperons, the relative number of experimental (measured and to be measured) and theoretical parameters are discussed. This yields the minimum conditions to test the theory. (Contractor's abstract)

2272

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

HYPERFINE STRUCTURE OF μ-MESIC ATOMS, by M. Le Bellac. July 1, 1962, 19p. incl. refs. (Technical note no. 6) (AFOSR-3104) (AF 61(052)474) AD 282109 Unclassified

Also published in Nuclear Phys., v. 40: 645-655, Feb. 1963.

The effects of the distribution of nuclear magnetization on hyperfine structure (Bohr - Weisskopf effect) are studied in the case of μ-mesic atoms. The "configuration mixing" model of nucleus is used for the calculation and it is shown that the reduction of hyperfine structure is of order 15% for Al^{27} and of order 50% for Bi^{209}. Calculations are also made in the framework of the collective model again for Al^{27} and also for Ta^{181}. The vacuum polarization effects on hyperfine structure are also studied and are found to be of order 1% for light nuclei. (Contractor's abstract)

2273

Paris U. Lab. de Physique Théorique [et Hautes Energies] (France).

THOMAS'S CLASSICAL THEORY OF SPIN, by H. Bacry. July 1, 1962, 12p. incl. refs. (Technical note no. 7) (AFOSR-3105) (AF 61(052)474) AD 282098 Unclassified

Thomas's work on the classical theory of spin is treated. The spin precession equation is generalized for variable electromagnetic fields and in the more general case of a bilocal theory.

2274

Paris U. [Lab. de Physique Théorique et Hautes Energies] (France).

INVARIANCE IN QUANTUM MECHANICS AND GROUP EXTENSIONS, by L. Michel. Oct. 15, 1962 [87]p. incl. diagrs. (AFOSR-4366) (AF 61(052)474) AD 294842 Unclassified

There is a review of certain topics connected with symmetry groups in quantum theory which are not very well known to most physicists A concise review of basic group-theoretic notions and connected physical considerations leads up to the central topic of the article, which is the problem of group extensions. This problem is the following: Given 2 groups A and B, find all groups E such that A is an invariant subgroup of E and B is the quotient E/A. In particular, the group E is called a central extension of B by A if A is abelian and A is a subgroup of the center of E. The characterization of central extensions of the connected Poincaré group by an arbitrary abelian group is given. Then the corresponding extensions for the extended Poincaré group are presented. It is shown that it is possible to generalize the results to extensions by a non-abelian group. Finally, questions of physical interpretation are discussed. (Math. Rev. abstract)

2275

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

THEORETICAL STUDY OF PARTICLE POLARIZATION IN HIGH ENERGY PHYSICS, by L. Michel. [1962] 33p. (AFOSR-5287) (AF 61(052)474) AD 417148 Unclassified

Covariant description of particles polarization is explained from the foundation of quantum theory and relativistic invariance. Several applications in high energy physics are presented.

2276

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

INTERACTION RANGE AND HIGH-ENERGY SCATTERING, by M. Lévy. [1962] [13]p. incl. refs. (AFOSR-2452) (AF EOAR-62-10) AD 280328 Unclassified

Also published in Nuovo Cimento, Series X, v. 24: 920-932, June 1, 1962.

A lower limit (R_{min}) of the interaction radius is calculated in terms of total and elastic cross-sections without the assumption that only a finite number of partial waves contribute to the scattering. It is shown that R_{min} can be evaluated exactly in the high-energy limit if the scattering amplitude satisfies a Mandelstam representation. Consequences on the range of the proton-antiproton interaction are discussed briefly. Finally, a slightly different estimate of R_{min} is made in the framework of diffraction scattering theory.

2277

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

ON THE THEORY OF CLASSICAL FLUIDS. II, by L. Verlet and D. Levesque. May 1962, 33p. incl. diagrs. tables, refs. (Technical note no. 3) (AFOSR-2529) (AF EOAR-62-10) AD 280022 Unclassified

Also published in Physica, v. 28: 1124-1142, Nov. 1962.

Using the Lennard-Jones potential the integral equation for the 2-body correlation function is solved and shown to give good results for argon at medium temperatures and densities, particularly near the critical point. The theory does not, however, appear to be successful at higher temperatures. (Contractor's abstract, modified)

2278

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

ON THE RELATIVISTIC DEGENERATE ELECTRON GAS, by B. Jancovici. Mar. 1962, 37p. incl. diagrs. (Technical note no. 4) (AFOSR-2701) (AF EOAR-62-10) AD 275844 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 428-455, July 16, 1962.

The properties of an electron gas are studied, at zero temperature and at a density high enough for the Fermi energy to be relativistic (such densities and relatively low temperatures occur in the interior of white dwarfs). The problem is studied in the dielectric formulation of the quasi-boson approximation: the electron-hole pairs, which appear because of the Coulomb interactions or the interactions with the transverse photon field, are treated like bosons, and the other processes than the creation and the annihilation of such pairs are neglected; the positrons are included among the possible holes. Model Hamiltonians are written down and diagonalized, which describe the system within this approximation. Longitudinal and transverse dielectric constants are computed, which depend on the wave-number and the frequency, and which describe the response of the system to external excitations; the necessary charge renormalization very naturally appears. The propagation of longitudinal and transverse waves is studied and the dispersion law is computed. Finally, the ground state energy is computed up to the term of order $e^4 \log e^2$. (Contractor's abstract)

2279

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

SOME REMARKS ON $K^+_{2\pi}$ AND K^+_{e4} DECAYS, by K. Chadan and F. M. Renard. [1962] [2]p. (AFOSR-3160) [AF EOAR-62-10] AD 289414 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 1405-1406, Dec. 16, 1962.

It is suggested that the small branching ratio for K_{e4} decay favors the Feinberg-Pais explanation of the $K^+_{2\pi}$ decay rate (ζ resonance).

2280

Paris U. [Lab. de Physique Théorique et Hautes Energies] (France).

[CRYSTALLOGRAPHY SET UP TO PERMIT STUDY OF SPECIFIC DEFECTS IN SOLIDS BY X-RAY DIFFUSION] Montage permettant l'etude des défauts ponctuels dans les solides par diffusion des rayons X, by A. M. Levelut, M. Lambert, and A. Guinier. [1962] [3]p. incl. diagr. (AFOSR-J84) (AF EOAR-62-51) AD 400096 Unclassified

Also published in Compt. Rend. Seances Acad. Sci., v. 255: 319-321, July 1962.

The sensitivity of the set up is obtained by enlarging the solid angle in which is gathered the diffuse energy. Some experiments with alloys increase the possibilities of the device.

2281

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

DEUTERON ELECTROMAGNETIC FORM FACTORS, by M. Gourdin. Nov. 1962, 22p. incl. diagrs. refs. (Technical note no. 7) (AFOSR-4362) (AF EOAR-63-47) AD 294841 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 533-546, May 1, 1963.

Using the impulse approximation with a nonrelativistic

wave-function for the deuteron an expression is derived for the deuteron electromagnetic current in terms of the nucleon electromagnetic scalar form factors. This is then re-interpreted in terms of charge, quadrupole and magnetic form factors of the deuteron and gives a particularly simple expression for the electron scattering differential cross-section. The approximations involved are then discussed. For instance, the expression for the magnetic moment gives a 3.9%-D state compared with experimental estimates of 6-7% from photodisintegration. It is concluded that a correct analysis of electron-deuteron scattering is difficult for momentum transfers above about 400 mev. (Contractor's abstract)

2282

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

SOME REMARKS ABOUT GAUGE INVARIANCE IN THE ISOBARIC MODEL FOR PHOTOPRODUCTION, by M. Gourdin and P. Salin. Oct. 1962, 6p. (Technical note no. 6) (AFOSR-4363) (AF EOAR-63-47) AD 294651 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 309-312, Jan. 1, 1963.

The gauge invariant formalism for the isobaric model is given in a Hamiltonian form for both spin $J = 3/2^+$ and $J = 3/2^-$ π-nucleon resonance. The phenomenological analysis is also given.

2283

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

ANALYSIS OF PHOTOPRODUCTION WITH AN ISOBARIC MODEL, by M. Gourdin and P. Salin. [1962] [15]p. incl. diagrs. refs. [AF EOAR-63-47] Unclassified

Published in Nuovo Cimento, Series X, v. 27: 193-207, Jan. 1, 1963.

An analysis of pion photoproduction on nucleons is made on the basis of a model where isobars simulate the final state interaction. The results relative to the $J = 3/2^+$ isobar are discussed. Agreement with experiment is obtained with a small electric transition $E_1^+/M_1^+ = -0.045$. This small electric quadrupole allows one to explain the recent experiments of photoproduction of neutral pions using polarized photons.

2284

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

RADIATIVE CORRECTIONS TO HIGH-ENERGY SCATTERING PROCESSES, by N. Meister and D. R. Yennie. [1962] [20]p. incl. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-63-47] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 130: 1210-1229, May 1, 1963.

A unified treatment of radiative corrections to a class of scattering experiments is presented. The experiments considered are those in which either (but not both) the scattered or recoil particle is detected. The recoil kinematics are properly treated and the calculation is simplified by retaining only terms of logarithmic order. The general results are applied to specific practical examples in which radiative corrections are likely to be important. Except possibly for the case of Compton scattering with nearly maximum or nearly minimum momentum transfer, the errors are estimated to be less than 2% of the cross section.

2285

Pavia U. Inst. of Physics (Italy).

EFFICIENCY OF THE VARLEY MECHANISM FOR VACANCY PRODUCTION IN ALKALI HALIDES, by G. Chiarotti and G. F. Nardelli. Apr. 25, 1962 [17]p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-2717) (AF 61(052)423) Unclassified

Also published in Radiation Damage in Solids; Proc. of Symposium on Radiation Damage in Solids and Reactor Materials, Venice (Italy) (May 7-11, 1962), Vienna, International Atomic Energy Agency, v. 3: 135-146, 1963.

The efficiency for the ejection of an ionized halogen from a regular lattice position into an interstitial position is investigated in the 2 cases of double ionization in inner and outer shells. The various contributions to the potential energy (Madelung, repulsive and polarization energies) have been evaluated for a number of points in the <111> direction with the aid of an electronic computer. The polarization energy has been estimated to zero-order approximation, and the repulsive interaction has been limited to the third neighbors. Inspection of the potential energy curves shows that, in the case of a halogen doubly ionized into inner shells, the ejection is highly improbable. On the contrary, the ejection mechanism might be operative when the halogen is doubly ionized into its outer shell, provided the time for the delocalization of the 2 holes is larger than 3×10^{-15} sec. (Contractor's abstract)

2286

Pennsylvania State U. [Dept. of Aeronautical Engineering] University Park.

EFFECT OF CHARGE SEPARATION ON SHOCK-WAVE STRUCTURE (Abstract), by R. D. Mathieu and H. Li. [1962] [1]p. [AF 49(638)647] Unclassified

Presented at meeting of the Amer. Phys. Soc., Northwestern U., Evanston, Ill., June 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 414, June 19, 1962.

The structure of a shock wave in a fully ionized hydrogen plasma is investigated using a 2-component fluid model consisting of electrons and singly charged ions. A set of macroscopic equations is written for each component. These equations are coupled through the momentum and energy-exchange terms between the components. The effects of viscosity and thermal conductivity are neglected. The ratio of mean free path to Debye length appears as a parameter. Results are obtained for Mach numbers of 1.1 and 1.2 The phenomenon of charge separation gives rise to an induced electric field within the plasma. At these Mach numbers and typical plasma conditions, the electric field is on the order of 12,000 v/cm. The fluid properties of the ions and electrons oscillate about and damp out to the equilibrium Rankine-Hugoniot values after the shock. As the mean free path between particles decreases, the oscillations damp out more rapidly and at the same time the oscillations become less frequent.

2287

Pennsylvania State U. [Dept. of Biology] University Park.

METABOLISM OF SULFATE BY THE CHROMATOPHORE OF RHODOSPIRILLUM, by M. L. Ibanez and E. S. Lindstrom. [1962] [5]p. incl. tables, refs. (AFOSR-4305) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-42 and National Science Foundation) Unclassified

Also published in Jour. Bacteriol., v. 84: 451-455, Sept. 1962.

The chromatophore of Rhodospirillum rubrum was shown to possess enzymes for the activation and reduction of inorganic sulfate. The chromatophore was able to synthesize 3'-phosphoadenosin 5'-phosphosulfate (PAPS), using either exogenous adenosine triphosphate (ATP) or ATP synthesized via photophosphorylation. Light was required for the reduction of sulfate to a volatile form, presumably sulfite. Light enhanced the incorporation of sulfate-sulfur into cystine, cysteine, and cysteic acid of the chromatophore. This incorporation was probably the result of exchange reactions of reduced sulfur, not the result of net synthesis. The 100:1 ratio of the activation to reduction of sulfate and the inhibition of the reduction by exogenous ATP suggested that PAPS might not be the substrate for chromatophoral sulfate reduction. (Contractor's abstract)

2288

Pennsylvania State U. [Dept. of Biology] University Park.

AN EFFECT OF CALCIUM ON THE MOTILITY OF RHODOSPIRILLUM RUBRUM (Abstract), by L. A. Feldman and E. S. Lindstrom. [1962] [1]p. (AF AFOSR-61-42) Unclassified

Presented at meeting of the Amer. Soc. Microbiol., Kansas City, Mo., May 6-10, 1962.

Published in Bacteriol. Proc., p. 60, 1962.

Calcium was shown to be necessary for the functioning of the flagellae of R. rubrum. Cells grown in a low Ca^{2+} had flagellae that were indistinguishable morphologically and serologically from flagellae from cells grown with ample Ca^{2+}. Growth was necessary to regenerate motility in cells transferred from a medium deficient in Ca^{2+} to a medium sufficient in Ca^{2+}. Apparently, Ca^{2+} functions in some internal structional or energy relationships to permit motility. (Contractor's abstract)

2289

Pennsylvania State U. Dept. of Chemistry, University Park.

REVERSIBILITY OF RADICAL-OLEFIN REACTIONS, by P. S. Skell. Final rept. Oct. 29, 1962, 5p. (AFOSR-3910) (AF 49(638)457) AD 601708 Unclassified

It was the major object of the program to learn the conditions necessary for radical decomposition with special emphasis on depropagation in polymer forming systems, depropagation being measured by cis-trans isomerization of isotopically labeled monomers. This objective was achieved for styrene and vinyl chloride. Concomitant with these studies, many areas dealing with reversibility of simpler radical-olefin additions and rearrangements were examined with considerable profit.

2290

Pennsylvania State U. [Dept. of Chemistry] University Park.

ROLE OF GROUND STATE IN SINGLET-TRIPLET TRANSITION PROBABILITIES, by L. Goodman and V. G. Krishna. [1962] [2]p. incl. table. (AFOSR-64-0253) (AF AFOSR-62-39) AD 432745 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2721-2722, Dec. 1, 1962.

The spin-orbit perturbations in azines are presented in tabular form. The transition moments of $S_0 \leftrightarrow T_1$ stolen from the singlet-singlet transitions, triplet-triplet transitions, and the dipole moments are given. The contributions to the singlet-triplet transition probability from the singlet-singlet transition, $S_0 \leftrightarrow S_k$, where S_k is the principal perturbing singlet state, are also presented. Results show that neglecting the perturbation of the ground state, as practiced uniformly before, has little justification. The leading contribution to $S_0 \leftrightarrow T_1$ in the diazines comes through the mixing of the singlet ground states. Wherever the possibility for $N \leftrightarrow V$ triplet-triplet transition exists, the mixing of the excited triplets with the ground state should not be neglected.

2291

Pennsylvania State U. [Dept. of Chemistry] University Park.

CHARGE TRANSFER INTERACTION BETWEEN IODINE AND AZINES: IONIZATION POTENTIALS OF AZINES, by V. G. Krishna and M. Chowdhury. [1962] [3]p. incl. diagrs. tables, refs. (AFOSR-64-0290) (AF AFOSR-62-39) AD 434510 Unclassified

Also published in Jour. Phys. Chem., v. 67: 1067-1069, May 1963.

This note is concerned with the complexes formed between iodine and monocyclic azines: pyridine, pyrimidine, pyrazine, and s-triazine. The aspects considered are: the perturbation of the visible band of iodine and the ultraviolet and infrared spectra of donor, the equilibrium constants of the molecular complexes formed, and the energy and extinction coefficient of the charged transfer (CT) bands. An important aspect of this investigation is its relation to the ionization potentials of azines. It is shown that azines are n-donors toward iodine. The trend of the charge transfer maxima indicates that the experimentally observed ionization potentials of the azines correspond to π-electron ionization.

2292

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

KINEMATICS OF COSSERAT CONTINUA, by S. C. Cowin and W. Jaunzemis. May 1962, 83p. incl. diagrs. refs. (Technical rept. no. 5) (AFOSR-3004) (AF AFOSR-62-115) AD 278706 Unclassified

This report summarizes and extends the main results in kinematics of oriented media. A review of kinematics of ordinary continua is included, and a study of multiple-space tensors and time-rates of tensors is presented in some detail.

2293

Pennsylvania State U. [Dept. of Mathematics] University Park.

PROPERTIES OF HARMONIC FUNCTIONS OF THREE REAL VARIABLES GIVEN BY BERGMAN-WHITTAKER OPERATORS, by J. Mitchell. [1962] [12]p. (AFOSR-3384) (AF 49(638)826) AD 416531 Unclassified

Presented at meeting of the Amer. Math. Soc., Cincinnati, Ohio, Jan. 1962.

Also published in Canad. Jour. Math., v. 15: 157-168, 1963.

Let C be a closed rectifiable curve not passing through the origin, which bounds a domain in the complex ζ-plane. Let $X = (x, y, z)$ be a point in euclidean 3-space F^3, and set $v(X, \zeta) = Z\zeta^2 + x\zeta + Z^*$, where $Z = 1/2$ $(iy = z)$, $Z^* = 1/2\ (iy - z)$. If $g(v, \zeta)$ is a function of the 2 complex variables v, ζ the Bergman-Whittaker operator defined by $H(X) = B(g) = \frac{1}{2\pi i} \int_C g(v, \zeta)\ \frac{d\zeta}{\zeta}$ generates harmonic functions H(X). This connection between functions of 2 complex variables and harmonic functions of 3 variables has been used extensively in the investigation of various functional properties of harmonic functions in E^3. In the present paper, consideration is given to the case in which the function $g(v, \zeta)$ is of the form $f(v, \zeta)p(v)$, where p is a meromorphic function of v with an infinity of poles and $\zeta^{-1} f(v, \zeta)$ is an entire function in both variables. The transform $H(X) = B(g)$ is studied in detail and a numb. of results, concerning the character of the singularities and some growth properties of H(X) are obtained. (Math. Rev. abstract)

2294

Pennsylvania State U. Dept. of Mathematics, University Park.

PROPERTIES OF COMPLETE ORTHONORMAL SYSTEMS ON MATRIX SPACES, by S. H. Tung. Sept. 1962, 67p. (AFOSR-3286) (AF 49(638)826) AD 621239 Unclassified

Properties of complete orthonormal systems (CONS) on the domain D in the 2 x 2 and n x n cases were studied. Complete orthonormal systems on B and D in the 2 x 2 and n x n cases were given by Mitchell. These systems provided the basic tool for this study. Some inequalities for trigonometric polynomials in one complex variable to analogous polynomials on the domain D were extended. An upper bound for derivatives of polynomials on D in the n x n case was derived. A summability theorem for a Fourier Bessel series was proved. Uniform boundedness of the difference kernel of Fourier-Bessel series and Fourier cosine series was established by means of asymptotic formulas for Bessel functions. With this, the equiconvergence theorem of the simple Fourier-Bessel and Fourier cosine series of Lebesgue integrable functions at every point was obtained. This led to a theorem for Cesáro equisummability of Fourier Bessel series of a real function on B and its corresponding Fourier trignometric series. The Poisson kernel for the domain D and the Dirichlet problem in D were used in proving Harnack's theorems. Other possible problems in the various chapters are discussed.

2295

Pennsylvania State U. [Dept. of Physics] University Park.

ULTRASONIC ATTENUATION IN POLYMERS AS A FUNCTION OF TEMPERATURE (Abstract), by J. N. Lange. [1962] [1]p. (AFOSR-65-1605) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-43 and Atomic Energy Commission) Unclassified

Presented at Sixty-fourth meeting of the Acoust. Soc. Amer., Seattle, Wash., Nov. 7-10, 1962.

Also published in Jour. Acoust. Soc. Amer., v. 34: 1984, Dec. 1962.

This study is concerned with determining the attenuation coefficient of various polymers in a frequency range from 1 to 15 mc and over a wide temperature range. In particular, the attenuation in polystyrene and polyethylene is studied. The results and technique are discussed. (Contractor's abstract)

2296

Pennsylvania State U. [Dept. of Physics] University Park.

DETERMINATION OF LOSS FACTORS OF MATERIALS IN POWDER AND GRANULAR FORM (Abstract), by M. M. Simon. [1962] [1]p. (AFOSR-65-1606) (AF AFOSR-63-43) Unclassified

Presented at Sixty-fourth meeting of the Acoust. Soc. Amer., Seattle, Wash., Nov. 7-10, 1962.

Also published in Jour. Acoust. Soc. Amer., v. 34: 2004, Dec. 1962.

This study concerns the determination of loss factors of materials in powder and granular forms by means of decay-time and bandwidth measurements. Two types of liquid-filled tubes are used for the experiment. One is a heavy walled stainless-steel cylinder driven by a steel membrane, the other is a glass U tube driven by a loudspeaker above the liquid column. The loss factors are determined for the liquid filled tubes. The material to be studied is then placed at a velocity node within the liquid, and the loss factor of the combination is determined. From these determinations, the loss factor of the additional material, as well as its bulk modulus of elasticity, can be calculated. (Contractor's abstract)

2297

Pennsylvania State U. [Field Emission Lab.] University Park.

SEEING ATOMS IN A MICROSCOPE, by E. W. Müller. [1956] [3]p. incl. illus. diagrs. (AFOSR-3508) (AF 18(600)672) Unclassified

Also published in Armed Forces Chem. Jour., v. 10: 13, 30, 38, Nov.-Dec. 1956.

For abstract see item no. PSU. 05:004, Vol. I.

2298

Pennsylvania State U. [Field Emission Lab.] University Park.

ATOMIC SURFACE STRUCTURE OF FIELD-EVAPORATED ALLOY CRYSTALS (Abstract), by E. W. Müller. [1962] [1]p. [AF 49(638)504] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 27, Jan. 24, 1962.

Although low-temperature field evaporation of pure metal crystals as used for tip specimens in the field ion microscope develops most perfect surfaces with thousands of high-index crystal facets, field evaporation of some alloys results in a more-or-less amorphous surface. This is due to the statistical distribution of the kind of nearest neighbors at each surface site. The degree of randomness is different for various alloys. In 50% W-Mo with the predominant 011, 112, and 001 planes typical for the bcc lattice, planes with indices such as 122, 123, and 334 may still appear, while in 50% Re-Mo, the field-evaporated surface is completely amorphous. Field electron emission from this surface shows almost no details, indicating that work function differences of various crystallographic orientations are not a volume effect. Ordered alloys such as 650°C annealed 50% Pt-Co develop highly perfect crystalline surfaces in which the 2 kinds of atoms can be distinguished in some parts of the field ion image. Disordering at 1000°C produces some randomness, although there is evidence of a persistent short-range order over areas of 30-50 A diam.

2299

Pennsylvania State U. [Field Emission Lab.] University Park.

OCCURRENCE OF H_3^+ IN THE FIELD IONIZATION OF HYDROGEN, by T. C. Clements and E. W. Müller. [1962] [4]p. incl. illus. diagrs. (AFOSR-J271) (AF AFOSR-62-96) AD 400883 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2684-2687, Dec. 1, 1962.

Mass spectroscopical analysis of the ions produced at a point emitter with dynamic supply of hydrogen at room temperature or in modified field ion microscopes at 78° and 20°K showed the abundant occurrence of H_3^+ besides H^+ and H_2^+ observed earlier by Inghram and Gomer. The triatomic molecule ion is formed only in the narrow range of field strength near best image conditions. The mechanism of H_3^+ formation under the extreme field conditions is uncertain. Field ion-microscopic observations shows H_3^+ only over single protruding surface atoms, which might act as sites for deactivation of an intermediate state, or simply provide a region of locally enhanced field to allow quick field ionization of short-lives H_3. (Contractor's abstract)

2300

Pennsylvania State U. Groth Inst., University Park.

RESEARCH IN MODERN CRYSTALLOGRAPHY, by R. Pepinsky. Final rept. Apr. 1, 1958-Feb. 28, 1962. Mar. 1962 [129]p. (AFOSR-3885) (AF 49(638)416) AD 285510 Unclassified

This research is directed at the assembly of all known

information on the physical, chemical and structural properties of solids, with the aim of facilitating discovery of known materials and development of new materials for military and other technological applications. Collation and correlation of this information will permit establishment of criteria by which known or new materials can be selected or prepared for examination for specific properties, and will maximize the predictability of behavior. It should be invaluable for purposes of identification. It should permit revelation of purely scientific relationships which are now obscured by the very mass of data. The amount of information to be handled is staggering, and about doubles each decade. A new approach to the preparation of a new type of encyclopedia is required. The deisgn of a suitable procedure was the first step in the present program and it has been accomplished. In the system adopted, all data are transferred to IBM punched cards, in a form suitable for efficient input to an IBM 704 machine after transfer to magnetic tape, and coded in such a manner that all useful computations can be carried out on simple instructions to the machine. Programs have been developed for processing the data, computing, correlating, preparing rapid-retrieval cards and tapes, and sorting out and automatically printing whatever information is desired and available. Rather than printing out everything that is known or knowable about solids, the information is left implicity in the storage to be made available on request.

2301

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

THEORY OF THE FERROELECTRIC EFFECT IN ROCHELLE SALT, by T. Mitsui. [1958] [9]p. incl. diagrs. refs. (AFOSR-4130) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)35, Atomic Energy Commission, and Signal Corps) Unclassified

Also published in Phys. Rev., v. 111: 1259-1267, Sept. 1, 1958.

For abstract see item no. PSU. 08:037, Vol. II.

2302

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

DIELECTRIC AND THERMAL STUDY OF $(NH_4)_2SO_4$ AND $(NH_4)_2BeF_4$ TRANSITIONS, by S. Hoshino, K. Vedam and others. [1958] [8]p. incl. diagrs. refs. (AFOSR-4131) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35, Atomic Energy Commission, and Signal Corps) Unclassified

Also published in Phys. Rev., v. 112: 405-412, Oct. 15, 1958.

For abstract see item no. PSU. 08:041, Vol. II.

2303

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

AMMONIUM HYDROGEN SULFATE: A NEW FERROELECTRIC WITH LOW COERCIVE FIELD, by R. Pepinsky, K. Vedam and others. [1958] [3]p. incl. diagrs. (AFOSR-4132) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35, Atomic Energy Commission, and Signal Corps) AD 414337 Unclassified

Also published in Phys. Rev., v. 111: 1508-1510, Sept. 15, 1958.

For abstract see item no. PSU. 08:038, Vol. II.

2304

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

NON-ISOMORPHISM OF FERROELECTRIC PHASES OF AMMONIUM SULFATE AND AMMONIUM FLUOBERYLLATE, by Y. Okaya, K. Vedam and R. Pepinsky. [1958] [1]p. (AFOSR-4134) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35, Atomic Energy Commission, and Signal Signal Corps) Unclassified

Also published in Acta Cryst., v. 11: 307, Apr. 10, 1958, 1958.

For abstract see item no. PSU. 08:035, Vol. II.

2305

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

FERROELECTRICITY IN AMMONIUM MONOCHLOROACETATE, by R. Pepinsky, Y. Okaya, and T. Mitsui. [1957] [1]p. (AFOSR-4135) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35, and Signal Corps) Unclassified

Also published in Acta Crystallog., v. 10: 600-601, Sept. [illegible], 1957.

For abstract see item no. PSU. 08:021, Vol. II.

2306

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

FERROELECTRICITY IN GLYCINE SILVER NITRATE,

by R. Pepinsky, Y. Okaya and others. [1957] [2½]p. incl. diagrs. (AFOSR-4136) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Signal Corps) Unclassified

Also published in Phys. Rev., v. 107: 1538-1539, Sept. 15, 1957.

For abstract see item no. PSU. 08:022, Vol. II.

2307

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

ROOM-TEMPERATURE FERROELECTRICITY IN LITHIUM HYDRAZINIUM SULFATE, $Li(N_2H_5)SO_4$, by R. Pepinsky, K. Vedam and others. [1958] [2]p. (AFOSR-4137) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Signal Corps) Unclassified

Also published in Phys. Rev., v. 111: 1467-1468, Sept. 15, 1958.

For abstract see item no. PSU. 08:039, Vol. II.

2308

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

DIELECTRIC AND THERMAL STUDY OF TRI-GLYCINE SULFATE AND TRI-GLYCINE FLUOBERYLLATE, by S. Hoshino, T. Mitsui and others. [1957] [4]p. incl. diagrs. refs. (AFOSR-4138) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Signal Corps) Unclassified

Also published in Phys. Rev., v. 107: 1255-1258, Sept. 1, 1957.

For abstract see item no. PSU. 08:020, Vol. II.

2309

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

X-RAY CRYSTALLOGRAPHIC STUDY OF ROOM TEMPERATURE MODIFICATION OF MONOMETHYLAMMONIUM ALUMINUM SULFATE ALUM, $(CH_3NH_3)[Al(H_2O)_6](SO_4)_2 \cdot 6H_2O$, by Y. Okaya, M. S. Ahmed and others. [1957] [12½]p. incl. illus. diagrs. tables, refs. (AFOSR-4139) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Signal Corps) Unclassified

Also published in Zeitschr. Krist. v. 109: 367-378, Dec. 1957.

For abstract see item no. PSU. 08: 027, Vol. II.

2310

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

SYMMETRY OF THE LOW-TEMPERATURE PHASE OF $BaTiO_3$, by F. Jona and R. Pepinsky. [1956] [4]p. incl. diagrs. refs. (AFOSR-4140) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Signal Corps) Unclassified

Also published in Phys. Rev., v. 105: 861-864, Feb. 1, 1957.

For abstract see item no. PSU. 08:009, Vol. I.

2311

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

NEUTRON DIFFRACTION STUDY OF ORTHORHOMBIC $BaTiO_3$, by G. Shirane, H. Danner, and R. Pepinsky. [1957] 20p. incl. diagrs. tables, refs. (AFOSR-4141) (In cooperation with Brookhaven National Lab., Upton, N. Y.) (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 Fourteenth Pittsburgh Diffraction Conf., Oct. 31-Nov. 2, 1956, Paper no. 44.

Also published in Phys. Rev., v. 105: 856-860, Feb. 1, 1957.

For abstract see item no. PSU. 08:011, Vol. II.

2312

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

X-RAY AND NEUTRON DIFFRACTION STUDY OF ANTIFERROELECTRIC LEAD ZIRCONATE, $PbZrO_3$, by F. Jona, G. Shirane and others. [1956] 1v. incl. illus. diagrs. tables, refs. (AFOSR-4142) (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

Abstract published in Program and Abstracts, Amer. Crystallographic Assoc., French Lick, Ind., June 1957, Paper no. E-4.

Also published in Phys. Rev., v. 105: 849-856, Feb. 1, 1957.

For abstract see item no. PSU. 08.003, Vol. I.

2313

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

A BRIDGE FOR ACCURATE MEASUREMENT OF FERROELECTRIC HYSTERESIS, by H. Diamant, K. Drenck, and R. Pepinsky. [1957] [23]p. incl. illus. diagrs. (AFOSR-4143) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)35] and Signal Corps) Unclassified

Also published in Rev. Scient. Instr., v. [illegible] 30-33, Jan. 1957.

For abstract see item no. PSU. 08:010, Vol. II.

2314

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

FERROELECTRICITY IN THE LANGBEINITE SYSTEM (Abstract), by F Jona and R. Pepinsky. [Aug. 15, 1956] [1]p. (AFOSR-4144) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)-35 and Signal Corps) Unclassified

Also published in Phys. Rev., v. 103: 1126, Aug. 15, 1956.

For abstract see item no. PSU. 08:005, Vol. I.

2315

Pennsylvania State U. X-Ray and Crystal Analysis Lab , University Park.

FERROELECTRICITY IN THE ALUMS, by R. Pepinsky, F. Jona, and G. Shirane. [1956] [2]p. incl. illus. diagr. (AFOSR-4145) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Signal Corps) Unclassified

Also published in Phys. Rev., v. 102: 1181-1182, May 15, 1956.

For abstract see item no. PSU. 07:002, Vol. I.

2316

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

X-RAY ANALYSES OF SOME COMPLEX-ION STRUCTURES, by Y. Okaya, R. Pepinsky and others. [1957] 14p. incl. tables. (AFOSR-4146) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)35, National Institutes of Health, and Office of Naval Research) Unclassified

Also published in Acta Crystallog., v. 10: 798-801, Dec. 10, 1957.

For abstract see item no. PSU. 07:010, Vol. II.

2317

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

AUTOMATIC INSTRUMENTATION, by R. Pepinsky. 1962, 29p. [AF 49(638)1044] Unclassified

Presented at Symposium on Recent Advances in Experimental and Theoretical Methods of Crystal Structure Research, Munich (Germany), July 28-31, 1962.

This report covers some of the automatic instruments used in experimental and theoretical methods of crystal structure research. The following applications are included: optical; mechanical; thermal; electrical and dielectric; crystal growth; shaping; x-ray fluorescence analysis; and x-ray and neutron diffraction. Computers are not included except for references to certain analogue devices which are directly coupled to automatic machines, and which have the advantage of permiting rapid introduction or adjustability of parameters and their immediate effects on the computations. It is estimated that in some instruments there is a savings of at least a factor of 4 in overall time and a gain of 5 in accuracy; the saving in tedium is extreme.

2318

Pennsylvania State U. [X-Ray and Crystal Analysis Lab. University Park.

ANTIFERROELECTRICITY IN $CsH_3(SeO_3)_2$ (Abstract), by Y. Makita and R. Pepinsky. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-367] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 177, Mar. 26, 1962.

Dielectric, pyroelectric, thermal, optical, and x-ray measurements are reported for paraelectric $CsH_3(SeO_3)_2$ above T_c = 145°K, and for the antiferroelectric phase below. The dielectric constant and temperature curves for these 2 phases are similar to those near the upper transition in $NaH_3(SeO_3)_2$. Various pyroelectric tests indicate essentially no spontaneous polarization. Correspondingly, no ferroelectric hysteresis appears; D vs E curves are linear, except for upward curvature in a narrow temperature range just below T_c when a strong field is applied perpendicular to (100). ϵ_1 (100) shows a peak at T_c which shifts to lower temperature on application of a biasing dc field. ΔT_c = 4.3°C for 32 kv/cm. ΔS = 0.81 cal/mol-deg. Assuming 2 equivalent sublattices below T_c and using Kittel's theory, P_s for a sublattice is ≈ 4.5 μcoul/cm^2. The upper phase has symmetry P2/m; the lower has a superstructure, and the symmetry is now under examination, as are the structures of both phases.

2319

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

CRYSTAL STRUCTURE OF FERROELECTRIC (GLYCINE)$_2$.MnCl$_2$.2H$_2$) (Abstract), by M. Lee, Y. Okaya, and R. Pepinsky. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-367] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 177, Mar. 26, 1962.

(Glycine)$_2$.MnCl$_2$.2H$_2$O, a room-temperature ferroelectric, has symmetry P2$_1$, with a = 9.96, b = 8.53, c = 6.86, β = 107°, Z = 2; the ferroelectric axis is along b. The structure was determined by full 3-dimensional methods and refined by least squares to R = 0.155. The absolute configuration was established from bounded P$_s$(u) projections, from which the structure was also discernable. Each Mn is coordinated octahedrally to 2 Cl's (trans), 2 H$_2$O's and 2 O's (1 from each glycine); the correct chemical name is thus syn-dichloro-bis-glycino-biaquo-manganese(II). The glycines are zwitter ions. H bonds from H$_2$O's to carboxyl O's result in infinite spirals of molecules parallel to b, and sheets parallel to (001); the sheets are interconnected by N-H···O and N-H···Cl bonds, accounting for the observed (001) cleavage. One H of each water is apparently not involved in H bonding. To account for the ferroelectricity, further anomalous, x-ray analyses are required.

2320

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

FERROELECTRIC POLARIZATION MECHANISM IN (NH$_4$)$_2$ (Abstract), by B. Singh and R. Pepinsky. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-367] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v 7: 177, Mar. 26, 1962.

Three-dimensional x-ray analyses of paraelectric and ferroelectric (NH$_4$)$_2$SO$_4$ and neutron analysis (at the Brookhaven reactor) at room temperature have clarified the polarization mechanism and other features of these structures. The paraelectric phase is comprised of a statistical mixture of 2 mirrored structures, producing a pseudomirror at z = 1/4; the true symmetry is thus Pna2$_1$ rather than Pnam. The 2 ammonium groups, NH$_4$(I) and NH$_4$(II), are unrelated crystallographically. NH$_4$(I) is very loosely bound to neighboring sulfates; all N-H···O distances are greater than 3 A and hindered rotation of NH$_4$(I) about c persists in both phases. NH$_4$(II) is more tightly bound but disordered about z = 1/4 above T$_c$, and is ordered below; this results in considerable tilt about c below T$_c$. There are 5 short N-O separations below T$_c$; H's in 4 of these separations are shown to be directly involved in the polarization. This dissimilar behavior of the 2 ammoniums may account for the double peak in specific heat.

2321

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

FERROELECTRICITY IN TRIS-SARCOSINE CALCIUM CHLORIDE (Abstract), by R. Pepinsky and Y. Makita. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-367] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 241, Mar. 26, 1962.

(Sarcosine)$_3$ CaCl$_2$ shows symmetry Pnma at 20°C. with a = 9.153, b = 17.48, c = 10.28 A, ρ_{obs} = 1.533 g/cc, Z = 4. Optically, the crystal is positive, with the acute bisectrix along a and the optic plane perpendicular to c. Twinning is common on {011} and similar to that in paraelectric (NH$_4$)$_2$SO$_4$, but is not temperature- or pressure-sensitive. Large crystals are easily grown from aqueous solution. A sharp dielectric peak appears along b[ϵ_b(max) ≈ 80] at 127°K, and ferroelectricity appears below this temperature, with saturated hysteresis loops. P$_s$ at 125°K ≈ 0.1, at 78°K ≈ 0.27 μ-cb/cm^2; E$_c$ at 125°K ≈ 0.6, at 78°K ≈ 3 kv/cm. ϵ_b follows a Curie-Weiss law above T$_c$[$\epsilon_b = C/(T - T_0)$]; T$_c$ - T$_0$ ≈ 0.5°, C = 72°K. The transition appears to be of second order, with ΔS = 0.38 cal/mol-deg. Assuming the second-order transition, ξ in the Gibbs free-energy equation is 3.6 x 10^{-6}(esu/cm^2)$^{-2}$. The ferroelectric phase has symmetry C$_{2v}$. Structure analysis of both phases are in progress.

2322

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

FIELD-REVERSIBLE OPTICAL ROTATION IN FERROELECTRIC LiH$_3$(SeO$_3$)$_2$ (Abstract), by H. Futama and R. Pepinsky. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-367], Medical Sciences Research Foundation, National Institutes of Health, and Phillips Laboratories) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 177, Mar. 26, 1962.

The room-temperature ferroelectric $LiH_3(SeO_3)_2$ crystallizes in space group Pn from an optically-inactive aqueous solution. Optical activity is possible in non-enantiomorphic point groups m and mm^2, and distinguishable from birefringence if the optic axial plane is perpendicular to reflection plane (s). In $LiH_3(SeO_3)_2$, the ferroelectric axis is perpendicular to (001); the crystal is optically negative for no light, the acute bisectrix is along [010], and $2V = 68 \pm 2°$. One-millimeter-thick plates are cut perpendicular to the optic axes, and electroded to permit ferroelectric polarization. A plate is oriented in a Rudolph spectropolarimeter with the optic beam (divergence < 4') along the optic axis. In accordance with Pepinsky's prediction, a saturating electric field causes optic rotation. At 5890 A, the rotation is ~ 4°; at 4000 A, it is tripled. Reversal of the electric field reverses the rotation. Measurements of dispersion, temperature dependence, switching times, and domain structure are presented.

2323

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

PHASE TRANSITIONS IN $NaH_3(SeO_3)_2$ (Abstract), by Y. Makita, K. Vedam, and R. Pepinsky. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-367] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Chem. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 241, Mar. 26, 1962.

$NaH_3(SeO_3)_2$ is ferroelectric below 194°K. Details of electrical, mechanical, optical, and thermal properties are reported here. Three phases are observed: (1) paraelectric above 194°K, space group $P2_1/n$; (2) ferroelectric between 194° and 94°K, triclinic, space group C1, spontaneous polarization close to [132] or [132] direction, twinning on (201) and (010) effected by shearing stresses; (3) ferroelectric below 94°K, probable symmetry Cs, polarization along [102]. For the transition at 194°K, $\Delta S = 0.97$ cal/mol-deg. Field-induced transitions are observable near the temperature extremes of phase (2); the temperature for the (1)-to-(2) transition is raised, and that of the (2)-to-(3) transition is lowered, by the field, indicating first-order transitions. Thermodynamic relations, and evidence for ferri-electric character, are discussed.

2324

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

REVERSAL OF OPTICAL ROTATORY POWER BY FIELD IN FERROELECTRIC CRYSTALS (Abstract), by R. Pepinsky. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-367], National Institutes of Health, and Phillips Laboratories) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 177, Mar. 26, 1962.

A ferroelectric crystal may have optically inactive pseudosymmetry (PS), whereas the true symmetry (S) permits optical rotation within individual domains. Examples above 250°K, with pseudo- (PS) and true (S) point-group symmetries indicated as (PS, S), are triglycine sulfate, etc (2/m, m); Ca_2Sr(propionate) (422, 4); $LiN_2H_5SO_4$ (mmm, mm2); NH_4HSO_4 $RbHSO_4$ (2/m, m); $LiH_3(SeO_3)_2$ (2/m, m); colemanite (2/m, 2); $NaNO_2$ (mmm, mm2). In m or mm2, ease of observability of the rotation depends on the orientation of the optic axes (as well as the magnitude of the rotation/mm within a single domain). The effect is readily seen along the optic axes in polarized $LiH_3(SeO_3)_2$, and polarization reversal alters the rotation sense. Unbiased crystals, comprised of equal volumes of oppositely-oriented 180° domains, show no rotation. In ferroelectric crystals with optically active pseudo-symmetries (e.g., Rochelle salt), polarization may cause incremental rotations. This phenomenon, when present, permits modulation of optical transmission and new methods for domain observation and switching. More important, anomalous x-ray diffraction analyses permit direct observation of interatomic bonds responsible for optical activity and correlation of the sense of rotation with absolute configuration.

2325

[Pennsylvania U., Philadelphia]

SEARCHING LEGAL LITERATURE ELECTRONICALLY: RESULTS OF A TEST PROGRAM, by J. S. Melton and R. C. Bensing. Reviewed by J. O'Connor. [1960] [19]p. (AFOSR-3376) (AF AFOSR-62-257) Unclassified

Presented at meeting of the Amer. Bar Assoc., Miami, Fla., Aug. 1959.

Also published in Minnesota Law Review, v. 45: 229-248, Dec. 1960.

A pilot system for machine searching of legal records has been developed using variations of a basic approach which was developed for the retrieval of scientific information. Subject indexing of a passage is done by someone "learned in the law." He writes down what he regards as the "significant words" and assigns them "role indicators," and punctuates this set of symbols.

Machine-aided searching, rather than searching aided only by printed indexes, has 2 advantages. First, in printed indexes, a term can be put under more than one heading only by repeating the term or by cross-referencing. Thus potentially useful information often is omitted. However, rapid machine searching makes feasible examination of every record in the file. Second, if the searching machine is fairly powerful, it can perform a number of searches simultaneously. This makes feasible the formulation of a number of questions of varying form for the same initial search request.

2326

Pennsylvania U. [Dept. of Chemistry] Philadelphia.

THE PROPERTIES OF SINGLE CRYSTAL GERMANIUM SURFACES. Final technical rept. [1962] 18p. incl. diagrs. refs. (AFOSR-J1131) (AF AFOSR-62-155) AD 420996 Unclassified

This study of ortho to para hydrogen conversion on germanium prepared under ultra-high vacuum conditions at very low temperatures was undertaken to obtain information on its surface magnetic properties, and, if possible, to use the conversion rate for determining the cleanness of the surface. The data available on germanium and silicon may be grouped into heat and non-heat treated surfaces. It is not known whether some rearrangements occur on surfaces created by crushing or cleaving. Thus, caution should be used in evaluating data obtained on differently treated surfaces. Typical examples of pressure vs resistance change graphs for n-hydrogen exposed to germanium for 2 hr at 13° and 77°K are shown It is concluded that germanium surface does not exhibit a strong paramagnetic susceptibility. However, with the present data, it is not possible to rule out a weak susceptibility.

2327

Pennsylvania U. [Dept. of Chemistry] Philadelphia.

MODEL FOR THE (100) SURFACES OF SILICON AND GERMANIUM, by M. Green. [1962] [2]p. incl. diagrs. table. [AF AFOSR-62-155] Unclassified

Published in Jour. Chem. Phys., v. 37: 458-459, July 15, 1962.

Low-energy electron diffraction studies of germanium and silicon suggest that the atoms of the (100) surface are displaced from their idealized positions in directions perpendicular to rows in the (110) azimuth, with adjacent rows displaced in opposite directions; the extent of the displacement is uncertain. No displacement has been observed on the (100) diamond surface. It is suggested that a covalent bond of normal length forms between those atoms which are displaced towards one another in the (100) surfaces of silicon and germanium, each surface atom having one unbound electron occupying a 3 sp^3 orbital. Energy calculations are given to support the suggestion in the cases of germanium, silicon, and diamond. In the case of diamond, the formation of surface bonding does not appear to be energetically favorable.

2328

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

REMOTE POINTS IN βR, by N. J. Fine and L. Gillman. [1961] [9]p. (AFOSR-3830) (AF 18(603)65) Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 29-36, Feb. 1962.

It has been known for some time that there is a point in βR (where R is the real line) that is not in the closure of any R-closed discrete subset of R. The main result of the paper is that, assuming the continuum hypothesis there is a point p in βR that is not in the closure of any discrete subset of R; equivalently, there is a maximal family of zero sets on R with the finite intersection property no member of which is nowhere dense. It is not determined whether the continuum hypothesis is necessary. The result is obtained from a more general theorem, which asserts that for a certain class of spaces, a point satisfying an even stranger condition exists if and only if the space is not pseudocompact. A result on pseudocompactness of sub spaces of βS when S is realcompact is also given and some examples are discussed. (Math. Rev. abstract)

2329

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

VARIATIONS ON EQUICONTINUITY, by J. P. Clay. [1962] [9]p. incl. refs. (AF 49(638)569) Unclassified

Presented at meeting of the Amer. Math. Soc., Feb. 1962.

Published in Duke Math. Jour., v. 30: 423-431, Sept. 1963.

The transformation group (X, T) is said to be almost equicontinuous provided that if $x \in X$ and if α is an index of X, then there exists an index β of X and a syndetic subset of A of T such that $t \in A$ implies $x\beta t \subset x t\alpha$; and (X, T) is said to be weakly almost equicontinuous provided that if $x \in X$ and if α is an index of X, then there exists an index β of X and a compact subset K of T such that if $y \in x\beta$, then there exists a subset A of T such that $T = AK$ and such that $t \in A$ implies $yt \in xt\alpha$. Among others the following theorems are proved: (1) (X, T) is locally almost periodic if and only if (X, T) is pointwise almost periodic and almost equicontinuous; (2) Almost equicontinuous and weakly almost equicontinuous are productive; (3) (X, T) is weakly almost equicontinuous if and only if $P = Q$; and (4) The unique existence of a universal admissible minimal transformation group where admissible is any one of 10 properties. (Math. Rev. abstract)

2330

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

ON THE ROLE OF CONDENSED VACANCIES AND INTERSTITIALS IN FATIGUE, by R. M. McCrone and D. Kuhlmann-Wilsdorf. Feb. 14, 1959, 2p. (AFOSR-2322) (AF 49(638)435) AD 611384 Unclassified

Also published in Naturwissenschaften, v. 46: 334-335, 1959.

For abstract see item no. 1590, Vol. III.

2331

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

APPARATUS FOR OBTAINING X-RAY EXTINCTION MICROGRAPHS OF SINGLE CRYSTALS, by R. K. McCrone. [1962] [13]p. incl. illus. diagrs. (AFOSR-4003) (AF 49(638)435) AD 290694 Unclassified

Also published in Rev. Scient. Instr., v. 33: 1244-1245, Nov. 1962.

An apparatus for obtaining x-ray extinction micrographs (Berg-Barrett micrographs) of single crystals is described. A simple method to orient the crystal for reflection for a predetermined plane is discussed. Finally, a selection of micrographs illustrating the high resolution of the apparatus is presented. (Contractor's abstract)

2332

Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia.

A NEW THEORY OF LINEAR WORKHARDENING, by D. Kuhlmann-Wilsdorf. [1962] [2]p. (AFOSR-4004) (AF 49(638)435) Unclassified

Also published in Zeitschr. Metall., v. 53: 324-325, 1962.

A new theory of linear workhardening in stage II of fcc metals is proposed which is based on 5 simple assumptions. The theory gives a quantitative explanation of the workhardening coefficient and can be applied to a wide range of metals and deformation conditions.

2333

Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia.

THE STRUCTURE OF DIMOLYBDENUM CARBIDE BY NEUTRON DIFFRACTION TECHNIQUE, by E. Parthe and V. Sadagopan. [1962] [10]p. incl. diagrs. table. (AFOSR-2386) (In cooperation with Massachusetts Inst. of Tech., Cambridge) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1027 and National Science Foundation) AD 611197 Unclassified

Also published in Acta Cryst., v. 16: 202-205, Mar. 10, 1963.

It is generally believed the Mo_2C has either the hexagonal C6 cadmium iodide anti-type structure or the related hexagonal L'3 structure. A neutron diffraction study showed that this is not the case. Mo_2C is only pseudohexagonal and crystallizes with an orthorhombic unit cell with $a = 4.72_4$, $b = 6.00_4$, and $c = 5.19_9$ A. The atomic arrangement of Mo_2C presents a new structure type. Space group is D_{2h}^{14}-Pbcn. Eight molybdenum atoms are in 8(d) with $x = 1/4$, $y = 1/8$, $z = 1/12$ and 4 carbon atoms are in 4(c) with $y = 3/8$. The carbon atoms in Mo_2C arrange themselves in such a way that each molybdenum atom has 3 nearly planar carbon neighbors. (Contractor's abstract)

2334

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

THE CRYSTAL STRUCTURES OF Sc_5Si_3, Sc_5Ge_3, La_5Ge_3, AND Ce_5Ge_3, by J. Arbuckle and E. Parthe. [1962] [3]p. incl. table. (AFOSR-2415) (AF 49(638)-1027) AD 295934 Unclassified

Also published in Acta Cryst., v. 15: 1205-1207, Dec. 1962.

The crystal structures of Sc_5Si_3, Sc_5Ge_3, La_5Ge_3, and Ce_5Ge_3 have been studied by means of Debye-Scherrer powder photographs. All compounds crystallize in the unfilled $Mn_5Si_3(D8_8)$ structure type. The hexagonal lattice constants of Sc_5Si_3 are $a = 7.861$ and $c = 5.812$A; those of Sc_5Ge_3 are $a = 7.939$ and $c = 5.883$A. The dimensions of La_5Ge_3 are $a = 8.958$ and $c = 6.795$A while those of Ce_5Ge_3 are $a = 8.875$ and $c = 6.570$A. All of the above compounds have an unusually large c/a ratio. (Contractor's abstract)

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Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia.

CRYSTAL CHEMISTRY OF METALLIC COMPOUNDS, by E. Parthe. Technical status rept. Jan. 1, 1962-Sept. 30, 1962 [23]p. incl. diagrs. tables. (Rept. no. 3) (AFOSR-2645) (AF 49(638)1027) AD 284060 Unclassified

The structure of NbAs has been solved and has been found to present a new structure type, which is a transposition structure variation of the WC structure type.

NbAs is tetragonal with a = 3.452A and c = 11.67_9A. Space group is C_{4V}^{11} - 14_1 md with 4Nb in 4a with z = 0 and 4As in 4a with z = 5/12. The same structure type has been found to apply to TaAs with a = 3.437A and c = 11.65_8A and "β-NbP" with a = 3.334A and c = 11.37_8A. The previously reported structure proposal for α and β -NbP was proven to be wrong. In the case of a gradual P deficiency, a gradual structural change of the NbAs structure type was observed, which corresponds to a gradual irregular transposition, presenting a structure halfway between NbAs and WC. The new structure type and its variation fit well with the other known monophosphide or arsenide structure types.

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Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

ON THE FORMATION OF $D8_8$ - PHASE BETWEEN IV GROUP TRANSITION METALS AND ALUMINUM, GALLIUM, INDIUM, AND ANTIMONY, by H. Boller and E. Parthe. Technical status rept. Jan. 1, 1962-Sept. 30, 1962 [11]p. incl. tables. (Rept. no. 4) (AFOSR-2646) (AF 49(638)1027) AD 284057 Unclassified

A search for the occurrence of compounds with $D8_8$ structure has resulted in the discovery of 3 new members: Ti_5Ga_3: a = 7.604 A, c = 5.288 A and c/a = 0.695; Hf_5Ga_3: a = 7.962 A, c = 5.677 A and c/a = 0.713; Zr_5Sb_3: a = 8.465 A, c = 5.806 A and c/a = 0.686. The free parameters for Hf_5Ga_3 and Zr_5Sb_3 have been found to be x_{Me} = 0.25 and x_X = 0.610, while the free parameters for Ti_5Ga_3 are slightly different with x_{Ti} = 0.24 and x_{Ga} = 0.605. The formation of the $D8_8$ - phases between Group IV transition metals and aluminum, gallium, indium and antimony is discussed. (Contractor's abstract)

2337

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

ON THE POSSIBILITY OF FORMING PSEUDOSILICIDES, by H. Boller and E. Parthe. Technical status rept. Jan. 1, 1962-Sept. 30, 1962 [12]p. incl. diagrs. tables. (Rept. no. 5) (AFOSR-2647) (AF 49(638)1027) AD 284058 Unclassified

Also published in Acta Cryst., v. 16: 830-833, Aug. 1963.

The concept of 'pseudosilicon' is very successful for the prediction of occurrence and structure of certain groups of nonmetallic compounds. Experiments to extend this concept to metallic compounds show that the concept has to be modified. Two factors have been found to be of importance for determining if a 'pseudosilicide' will occur. One is the composition of the compound and the second is a geometrical factor which depends on the crystal structure type. It is known that compounds of the 'pseudosilicon' type, and also nonmetallic 'pseudosilicon' oxide, have extremely narrow homogeneity ranges, but transition metal 'pseudosilicides' exhibit wide ranges which may spread far from the ideal composition of the 'pseudosilicide'. Alloys close to the composition of the 'pseudosilicide' show a chemical stabilization like increased oxidation resistance and also a volume contraction. Two new true 'pseudosilicides' have been synthesized: $Hf_5(In_{0.5}Sb_{0.5})_3$ with $D8_8$ structure: a = 8.46A, c = 5.79A and c/a = 0.684; and $Mo(Al, P)_2$ with C40 structure: a = 4.76A, c = 6.64A and c/a = 1.40. Results are further reported on the following ternary sections: Nb_3Al-Nb_3Sb, Nb_3Ga-Nb_3Sb, Nb_3In-Nb_3Sb, (Zr_5Al_3)-Zr_5Sb_3, Zr_5Ga_3-Zr_5Sb_3, (Zr_5In_3)-Zr_5Sb_3 and Ti_5Ga_3-(Ti_5Sb_3). (Contractor's abstract)

2338

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

THE CRYSTAL STRUCTURES OF Sc_5Si_3, Sc_5Ge_3, La_5Ge_3, AND Ce_5Ge, by J. Arbuckle and E. Parthe. [1962] [3]p. incl. tables. (AFOSR-4402) (AF 49(638)-1027) Unclassified

Also published in Acta Cryst., v. 15: 1205-1207, Dec. 10, 1962.

For abstract see item no. 2334, Vol. VI.

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Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

NOTE ON THE STRUCTURE OF ScP AND YP, by Edda Parthe and Erwin Parthe. [1962] [1]p. (AF 49(638)-1027) (AFOSR-J717) AD 413966 Unclassified

Also published in Acta Cryst., v. 16: 71, Jan. 10, 1963.

An x-ray investigation has shown that ScP and YP crystallize in the NaCl(B1) structure. The lattice constants are 5.312A for ScP and 5.661A for YP. One may assume a certain amount of homeopolar and metallic bonding in these compounds. In agreement with the last statement is the metallic luster observed with ScP and YP samples.

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Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

THE TRANSPOSITION STRUCTURE OF NbAs AND OF SIMILAR MONOPHOSPHIDES AND ARSENIDES OF NIOBIUM AND TANTALUM, by H. Boller and E. Parthe. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J1599) (AF 49(638)1027) AD 427625 Unclassified

Also published in Acta Cryst., v. 16: 1095-1101, Nov. 1963.

NbAs crystallizes in a new structure type, which is a transposition structure variation of the WC structure type. NbAs is tetragonal with a = 3.45$_2$A and c = 11.67 11.67$_9$A. The space group is $I4_1md$ (C_{4v}^{11} with 4Nb in 4a with z = 0 and 4As in 4a with z = 5/12. Other isotypic compounds are TaAs with a = 3.43$_7$A and c = 11.65$_6$A and 'β-NbP' with a = 3.33$_4$A and c = 11.37$_8$A. The previously proposed structure for α and β-NbP is proved to wrong. Stoichiometric NbP or 'β-NbP' crystallizes in the NbAs structure, but P-deficient NbP_{1-x} has a partly disordered NbAs structure. The transposition is not as regular as in stoichiometric NbP. The degree of disorder depends nearly linearly on phosphorus deficiency. The new structure type is compared with other known monophosphide structure types. The concept of a structural transposition and its cancellation offers a new viewpoint for an explanation of the occurrence of more than 1 crystal structure for the same compound. (Contractor's abstract)

2341

Pennsylvania U. Dept. of Physics, Philadelphia.

SYSTEM FOR ENERGY CONTROL AND ABSOLUTE CALIBRATION OF A 23 MEV BETATRON, by K. N. Geller. [1962] [8]p. incl. diagrs. (AFOSR-J631) (AF 49(638)454) AD 414208 Unclassified

Also published in Nuclear Instr. and Methods, v. 17: 161-168, Oct. 1962.

The theoretical and technical features of a system used to determine and control the operating energy of a 23 mev betatron are described. By observing the variation in orbit radius as a function of magnet excitation, the shape of the calibration curve to maximum operating energy is predictable. Although an absolute calibration of the predicted energy scale is possible, the present calibration is empirical and based on only the 16.22 mev resonance in the $O^{16}(\gamma,n)O^{15}$ reaction. Photoneutron threshold energies based on the present energy scale are in good agreement with accepted values. (Contractor's abstract)

2342

Pennsylvania U. [Dept. of Physics] Philadelphia.

[RESEARCH ON SCATTERING AND POLARIZATION OF ELECTRONS UNDER THE G FACTORS OF THE F FREE ELECTRON], by A. K. Mann. Final rept. Jan. 1, 19[illegible] Sept. 30, 1961. July 1962, 62p. incl. diagrs. refs. (AFOSR-3147) (AF 49(638)537) AD 613546 Unclassified

The possibility of obtaining spin-exchange orientation of a number of third and fifth column elements, with $^2P_{I/2}$ and $^4P_{3/2}$ ground states respectively, was investigated without success during this period. Failure with the fifth column elements may be due to strong chemical affinity with the Rb vapor, which either greatly broadens the resonances or completely dominates the spin-exchange process. This explanation is not entirely satisfactory however, due to the established ability to obtain spin-exchange orientation of atomic nitrogen. Failure with the third column elements may be due to excessive broadening of the resonance lines due to interactions of the $P_{1/2}$ ground-state atoms. Success was achieved with spin-exchange orientation of Ag atoms in a sealed vessel, duplicating recent results of other investigators. The possibility of observing Au and Cu orientation through use of the hyperfine resonance was investigated, with a search being made for the hf resonance in oriented Ag vapor. Success was not achieved, due to the very poor phase stability of the resonance, making effective use of the lock-in detector system impossible. A new rf powered Rb resonance lamp of the type developed by Varian Associated was constructed and tested. The lamp appeared to be of about the same resonance intensity as that previously used, but was free from troublesome plasma oscillations.

2343

Pennsylvania U. [Dept. of Physics] Philadelphia.

SEARCH FOR SPIN-EXCHANGE ORIENTATION OF 3RD AND 5TH COLUMN ELEMENTS IN THE PRESENCE OF OPTICALLY ALIGNED Rb VAPOR (Abstract), by R. L. de Zafra. [1962] [1]p. (AF 49(638)537) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 15, Jan. 24, 1962.

A search has been made for orientation produced in the third column elements B, Al, Ga, and In, and in the fifth column element Sb by electron exchange with optically pumped Rb vapor, in a sealed glass system. The technique used was that first employed by Dehmelt in which the Rb vapor acts as both polarizer and analyzer for the "foreign" vapor. Low-field Zeeman transitions were searched for in the ground state of the third column ($^2P_{1/2}$) and fifth column ($^4S_{1/2}$) elements over a fairly wide range of vapor densities. A lock-in detection system allowed signals as low as 10^{-3} (Rb Zeeman transition signal) to be easily detected. No resonance signals were observed for any of the elements tested, although the Zeeman signal from spin-exchange oriented Ag (ground-state $^2S_{1/2}$) could readily be observed, with a signal strength on the order of 1/10 the Rb^{85} signal strength, consistent with the results of Hayne and Robinson. Spurious resonance signals were also observed at a frequency corresponding to $g_F = 1$ when searching for resonance in certain samples of Al, and were probably due to atomic hydrogen freed during heating of the sample. Possible reasons for negative results with the third and fifth column elements are discussed.

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Pennsylvania U. Office of Computer Research and Education, Philadelphia.

TOWARDS A THEORY OF RECURSIVE PROCESSORS, by P. Z. Ingerman. [1961] 14p. (AFOSR-1472) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951 and National Science Foundation) Unclassified

This paper presents some definitions towards a theory of recursive processors and some theorems which have been proved concerning recursive processors. The criterion used in the definitions is that, although rigorous, they must also not contradict the intuition of persons who have been designing processors for years on (at least partially) an intuitive basis. Given the definitions, several theorems may be proved which give an insight into the intuitive portion of the techniques at present used for the construction of processors.

2345

Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

AN AXIOMATIC APPROACH TO PREFIX LANGUAGES, by S. Gorn. [1962] [24]p. incl. table. (AFOSR-2097) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951 and National Science Foundation) AD 289182 Unclassified

Also published in Symbolic Languages in Data Processing; Proc. of the Symposium, Rome (Italy) (Mar. 26-31, 1962), New York, Gordon and Breach, 1962, p. 1-21.

A set of axioms is presented which characterizes those linear sequential languages over a "stratified alphabet" called "complete prefix language". Such concepts as "local uniformity", "uniformity", "contractibility", "expandibility", and "homogeneity" are definable properties of such "generalized prefix languages". The definitions are mathematically formal but are purely extensional and non-constructive. This is in contrast with the "mechanically intensional" but constructive definitions by which the mechanical languages under discussion are presented in the computer and information sciences. The advantage in having such a mathematical theory of prefix languages available is that it would lead to a general "structural theory" of appropriate "sublanguages". Parts of such a structure theory could be used to discover how to "extend" languages by some appropriate standard "adjunction" processors. Control systems for the processing of mechanical languages which include such automatic extension processors will provide primitive models of "growing mechanical languages" and the growth and subsidence of corresponding "information retrieval problems". (Contractor's abstract, modified)

2346

Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

PROCESSORS FOR INFINITE CODES OF THE SHANNON-FANO TYPE, by S. Gorn. [1962] [25]p. incl. diagrs. (AFOSR-2595) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951 and National Science Foundation) AD 289475 Unclassified

Also published in Proc. Symposium on Mathematical Theory of Automata, New York (Apr. 24-26, 1962), ed. by J. Fox, M. Crowell, and R. Meyerson. Brooklyn, Polytechnic Press, 1963, p. 223-240.

Standard processors, reported elsewhere, are given which do the following: (1) Given a finite rooted tree, presented in one of the author's tree-naming languages, the first processor in a single scan generates "tree-addresses," for each node, from given-ordered alphabets in a generalized Dewey-decimal code. (2) A similar processor generates the addresses of the end points only, yielding a generalization of the Shannon-Fano code. (3) Such an end-point code, when sorted in order of appearance in prefix language, is lexicographically arranged; with ordering determined by a "depth language" it sorts by length first, and then lexicographically. The third processor uses either of these orderings to "deconcatenate" code in a single scan; the second ordering is more efficient. It is possible to generalize such codes and processors further to include end-point codes for infinite trees. The codes and processors are effective for those infinite trees which are "periodic." Any " "rooted" finite graph may be "broken open" into such an infinite periodic tree. The end-point codes generated by such graphs form the extents of mechanical languages which result from Chomsky phrase structure grammars of type 3. An example is given of an infinite end-point code which cannot be so generated (it is probably a phrase-structure language of type 1).

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Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

AMBIGUITY-PREVENTING NORMAL FORMS FOR SYNTAX SPECIFICATION, by R. M. Cotton. June 1962 [25]p. (AFOSR-3429) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951 and National Science Foundation) AD 285579 Unclassified

The question whether a formal computing language contains syntactic ambiguities has both theoretical and practical interest, as experience with ALGOL 60 has shown. It has been demonstrated that there is no decision procedure for determining whether an arbitrary language specified in Backus Normal Form contains such ambiguities. This paper investigates restrictive conditions on BNF rule sets sufficient to prevent ambiguities from occurring. In this way normal forms within BNF are defined which can be termed ambiguity-preventing. Some of these normal forms are sufficiently expressive to permit the specification of some or all of ALGOL. It is

shown that there are efficient algorithms for the syntactic recognition of languages specified by means of these normal forms. An algorithm is given in an appendix for the systematic discovery of all recognition trees of a string in an arbitrary (ambiguous) BNS specified language. Also, a proof of the unsolvability theorem referred to above is given. (Contractor's abstract)

2348

Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

DETECTION OF GENERATIVE AMBIGUITIES IN CONTEXT-FREE MECHANICAL LANGUAGE, by S. Gorn. [1962] [21]p. incl. diagrs. (AFOSR-3481) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)95' and National Science Foundation) Unclassified

Abstract published in Information Processing; Proc. of the Internat'l. Fed. for Information Processing Cong., Munich (Germany) (Aug. 27-Sept. 1, 1962), Amsterdam, North-Holland Publishing Co., 1963, p. 515-516.

Also published in Jour. Assoc. Comput. Mach., v. 10: 196-208, Apr. 1963.

The author relates his work to the Chomsky-Schützenberger representation of context-free languages using a graph and the 2 operations of disjunction and concatenation instead of a set of equalities and 2 operations noted sum and product. The problem of determining whether an arbitrary c.-f. grammar is ambiguous or not is known to be recursively unsolvable. The author detects ambiguities for finite subsets of c.-f. languages; to do this, he gives a sequence of algorithms to apply to a c.-f. grammar: elimination of certain superfluous rules; derivations of sentences are generated level by level, the levels being related to the steps of production of sentences in the Chomsky-Schützenberger scheme; comparisons of the derivations up to a level n are done, providing the list of ambiguous sentences. (Math. Rev. abstract, modified)

2349

Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

THE COMPUTER AND INFORMATION SCIENCES: A NEW BASIC DISCIPLINE, by S. Gorn. [1962] [9]p. (AFOSR-3482) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951, National Science Foundation, and Rome Air Development Center) Unclassified

The information processing area is developing into a new basic discipline which will be as fundamental in future university curricula as those now presented in the departments specializing in mathematics and in the natural language of the country to which the university belongs. A central topic in this discipline is the study of the synthesis and analysis of mechanical languages and their processors, where the word processor is interpreted broadly to refer to mechanisms, to programs for a mechanism, and to systems and organizations composed of mechanisms, programs, and algorithmized people. Special attention must be given to the study of these languages and their processors as growing organisms whose growth may be mechanically controlled. Like the tangent disciplines of psychology and linguistics, and unlike the tangent discipline of mathematics, it must be concerned with pragmatic phenomena in addition to semantic and syntactic questions. (Contractor's abstract, modified)

2350

Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

A TRANSLATION TECHNIQUE FOR LANGUAGES WHOSE SYNTAX IS EXPRESSIBLE IN EXTENDED BACKUS NORMAL FORM, by P. Z. Ingerman. [1962] [42]p. incl. tables, refs. (AFOSR-J237) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951 and National Science Foundation) AD 407528 Unclassified

Also published in Symbolic Languages in Data Processing; Proc. of the Symposium, Rome (Italy), (Mar. 26-31, 1962), New York, Gordon and Breach, 1962, p. 23-64.

The well-formedness of R(L), the set of rules which are the grammar of some language L with names N(L), basic symbols B(L), and expressions E(L) is considered. A restriction on R(L) is stated: for every element of N(L) there is at least one string of elements of B(L) which can be generated by a processor designed to generate words in a language given a name and a grammar. A rule-chain is defined as a sequence of rules, all elements of R(L), such that the metaresult of the k'th rule is one of the metacomponents (or the sole metacomponent) of the $(k+1)^{st}$ rule. Finally, the set of heads of a language is defined as the subset of N(L) which appear as metaresults but not as metacomponents. Without loss of generality (since additional rules can be introduced), only single-headed languages are considered.

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Pennsylvania U. Office of Computer Research and Education, Philadelphia.

MECHANICAL PRAGMATICS: A TIME-MOTION STUDY OF A MINIATURE MECHANICAL LINGUISTIC SYSTEM, by S. Gorn. [1962] [14]p. incl. diagrs. refs. (AFOSR-J245) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951, National Science Foundation and Rome Air Development Center) AD 407529 Unclassified

Also published in Commun. Assoc. Comput. Mach., v 5: 576-589, Dec. 1962.

This report begins with a miniature object language and its syntax, and proceeds to put both through a series of modifications. Each modification will either change the intent in the syntax language alone, or will keep the total intent fixed but will permit an exchange between the

object and syntax languages, thereby modifying both. In short, the pirpose here is to present with a small example a picture of the dynamic relationship between object languages, their syntax languages and their interpreters; this dynamic relationship, intended to be a mechanical one, is one of mutual growth and exchange.

2352

Pennsylvania U. School of Medicine, Philadelphia.

HYPOTHALAMIC CORTICOTROPIN AND LUTEINIZING HORMONE RELEASING FACTORS, by S. M. McCann. [1962] [6]p. incl. diagrs. refs. (AFOSR-2001) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and National Institutes of Health) AD 277645 Unclassified

Also published in Advances in Neuroendocrinol.; Proc. of the Symposium, Miami, Fla. (Dec. 6-8, 1961), Urbana, Illinois U. Press, 1963, p. 328-333.

Several points with regard to the existence of corticotropin releasing factors distinct from vasopressin are emphasized. Some of the recently obtained evidence pointing to the existence of luteinizing hormone releasing factors in extracts of the stalk-median eminence region are outlined. It is concluded that a specific luteinizing hormone (LH) releasing factor exists in stalk-median eminence extract tissue which is effective in stimulating LH secretion by the hypophysis, except when the secretion rate of LH is already maximal, as appeared to be the case in the ovariectomized rat.

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Pennsylvania U. School of Medicine, Philadelphia.

RECENT STUDIES ON THE REGULATION OF HYPOPHYSIAL LUTEINIZING HORMONE SECRETION, by S. M. McCann. [1962] [15]p. incl. diagrs. table, refs. (AFOSR-2633) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and Public Health Service) AD 408074 Unclassified

Also published in Amer. Jour. Med., v. 34: 379-393, Mar. 1963.

The recent development of a highly sensitive assay for luteinizing hormone (LH), the ovarian ascorbic acid depletion method, has made possible a systematic study of the factors influencing the secretion of this trophin in the rat. Elimination of negative feedback from ovarian steroids by gonadectomy resulted in elevated levels of LH in the pars distalis and plasma. Injection of ovarian steroids in such animals produced a decrease in the plasma titer of LH. Estrogen was effective in small amounts, progesterone in physiologic doses only after priming of the animal with estrogen. Lactation, perhaps acting through the suckling stimulus itself, also acted to inhibit LH secretion. LH secretion appears to be regulated by the hypothalamus since certain lesions in this structure markedly reduced both the secretion and storage of the trophin by the pituitary gland. Conversely, hypothalamic stimulation evoked the secretion of LH. The hypothalamus appears to exert its control over LH secretion by means of a humoral substance, designated luteinizing hormone-releasing factor (LH-RF) which is released into the hypophysial portal vessels and triggers the discharge of LH by an action on the hypophysis itself. The nature of this substance is unknown, but it may be a polypeptide related to the known neurohypophysial hormones.

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Pennsylvania U. School of Medicine, Philadelphia.

REGULATION OF LUTEINIZING HORMONE (LH) SECRETION BY A HYPOTHALAMIC LH-RELEASING FACTOR, by S. M. McCann, D. Ramirez, and R. Adams. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-2634) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and Public Health Service) Unclassified

Also published in Hormonal Steroids; Biochemistry, Pharmacology, and Therapeutics; Proc. of the First Internat'l. Cong., Milan (Italy) 1962, ed. by L. Martini and A. Pecile. New York, Academic Press, v. 1: 251-258, 1964.

The ovarian ascorbic acid depletion method has been used to study the factors regulating the secretion of LH; this secretion is subject to negative feedback control by the ovarian steroids estrogen and progesterone. It is also inhibited by laciation, possibly acting via the suckling stimulus. Hypothalamic lesions interfere with the secretion and storage of LH; conversely, LH secretion is induced by hypothalamic piqure. Crude extracts of the stalk-median eminence region evoke LH secretion in a variety of test situations. This activity is not due to LH or to contamination with a variety of known pharmacologically active agents. It is trypsin labile, a fact suggesting that the active substance may be a polypeptide. The most sensitive test system so far described for this LH-RF is the ovariectomized estrogen-progesterone blocked rat. Since conditions which markedly alter ACTH secretion have little or no influence on LH secretion, it is postulated that the LH-RF is not identical with CRF.

2355

Pennsylvania U. School of Medicine, Philadelphia.

NEUROHUMORAL CONTROL OF THE PITUITARY, by S. M. McCann. Final rept. Aug. 1, 1959-July 31, 1962. Nov. 21, 1962 [7]p. (AFOSR-4341) (AF 49(638)685) AD 293154 Unclassified

Investigations have been carried out to more clearly define the hypothalamic control over the anterior pituitary with particular emphasis on ACTH and gonadotrophins. In the case of ACTH, very little residual ACTH secretion occurs in rats with hypophyses engrafted to the kidney capsule. Attempts to significantly alter the content of stored CRF by altering the titer of circulating corticoids were unsuccessful. In the case of the gonadotropins, it is shown that hypothalamic lesions lead to elevated secretion of LTH and markedly reduced secretion of LH. Hypothalamic stimulation augments LH secretion and

evidence is presented indicating that LH release may be triggered by a hypothalamic LH-releasing factor. Since the conditions governing secretion of LH and ACTH have been demonstrated to be different, it is postulated that the LH-RF is different from CRF. Additional studies have dealt with the factors governing the secretion and storage of LH.

2356

Pennsylvania U. School of Medicine, Philadelphia.

COMPARISON OF THE REGULATION OF LUTEINIZING HORMONE (LH) SECRETION IN IMMATURE AND ADULT RATS, by D. V. Ramirez and S. M. McCann. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-J646) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-133 and National Institutes of Health) AD 414519 Unclassified

Also published in Endocrinol., v. 72: 452-464, Mar. 1963.

A careful study of some factors influencing LH secretion and storage has been made in immature and adult rats of both sexes. The ovarian ascorbic acid assay for LH has been utilized throughout. The LH content of the anterior lobe was 19.8 μg/gland in immature females and 23.3 μg/gland in adults. In immature males the content (7.0 μg/gland) was lower than that in immature females and rose markedly to a value of 32.9 μg/gland in adults, a value which was greater than that found in adult females. No detectable LH was found in plasma from rats with intact gonads except in the case of adult males, in which minimal levels were detectable. Two to 3 weeks following gonadectomy, pituitary LH content had risen significantly in both adult females and immature males, whereas it remained unchanged in immature females and adult males. By contrast with the variable response to gonadectomy seen in the hypophysis, plasma LH activity increased significantly in all gonadectomized groups. When expressed on a weight basis, equivalent LH-releasing activity was found in stalk median eminence extracts from immature and adult males on iv injection into immature females which had been pretreated with gonadotrophins. Extracts prepared from immature and adult rats of both sexes elevated the plasma LH activity in ovariectomized, estrogen-progesterone blocked rats. From the above results it appeared that all LH-releasing machinery of adults was present in immature animals. Daily sc injections of estradiol benzoate in immature and adult oophorectomized females lowered plasma LH below that found in controls, but immature animals were 2-3 times more sensitive to this effect of estrogen than adults. Estrogen also reduced hypophysial LH content, which indicates that it blocks synthesis as well as secretion of LH. (Contractor's abstract, modified)

2357

Pisa U. (Italy).

NEUROPHYSIOLOGICAL STUDIES OF CONDITIONING, by G. Ricci. [Final rept.] June 30, 1962 [19]p. incl. refs. (AFOSR-3218) (AF EOAR-61-36) AD 293101 Unclassified

The modifications of the visual system during avoidance conditioning to sound have been studied by recording the modifications of cortical and subcortical responses to flashes of light, as well as changes of the pupillary diameter accompanying conditioning. The modifications of the responses evoked in the sensory motor cortex by VPL stimulation have been followed during habituation, early and late stages of conditioning. In this cortical area, modifications of the responses to transcallosal stimulation during conditioning have also been studied. Changes of excitability of the sensory-motor cortex and of the VPL nucleus of the thalamus have been investigated, by studying the variations of responsiveness of the muscles of the arm to electrical stimuli applied to these brain structures during spontaneous and conditioned motor activity. (Contractor's abstract)

2358

Pisa U. (Italy).

[ALGEBRAIC DEPENDENCE THEOREMS ON COMPLEX PSEUDOCONCAVE SPACES] Dépendance algébrique et fonctions méromorphes sur les espaces pseudoconcaves, by A. Andreotti. Sept. 1, 1962, 68p. incl. refs. (Technical note no. 1) (AFOSR-3770) (AF EOAR-62-35) AD 287775 Unclassified

Also published in Bull. Soc. Math. (France), v. 91: 1-38, 1963.

The notion of pseudoconcave space is introduced and classical theorems on algebraic dependence of meromorphic functions are extended for this new class of spaces and for sections in a coherent sheaf.

2359

Pisa U. (Italy).

RESEARCHES ON PSEUDOCONVEX AND PSEUDOCONCAVE COMPLEX SPACES, by [A. Andreotti]. Technical rept. Nov. 1, 1961-Nov. 30, 1962 [5]p. (AFOSR-4235) (AF EOAR-62-35) AD 292904 Unclassified

The theory of pseudoconcave space, the study of deformation of Stein manifolds, and the investigation of topological properties of Runge Pairs are presented.

2360

Pisa U. (Italy).

ON THE PSEUDO-RIGIDITY OF STEIN MANIFOLDS, by A. Andreotti and E. Vesentini. [1962] [11]p. (AFOSR-J531) (AF EOAR-62-35) AD 407855 Unclassified

Also published in Ann. Scuola Norm. Super. Pisa, Series 3, v. 16: 213-223, 1962.

The present paper is devoted to proving that any family of Stein manifolds whose parameter space is an open set in some numerical space C^m gives a class of pseudo-trivial local deformations. For Stein manifolds of

dimension 1, i.e. for non-compact connected Riemann surfaces, this result was proved, using the potential theory, by M. S. Narasimhan. The proof is a straightforward application of the theory of deformations developed by K. Kodaira and D. C. Spencer modulo some minor changes to adapt it to the case of deformations of non-compact spaces. The theorem given here is a particular case of an analogous theorem concerning 1-convex spaces, but the proof of it is technically more involved.

2361

Pisa U. (Italy).

A NOTE ON STEIN SPACES AND THEIR NORMALISATIONS, by R. Narasimhan. [1962] [7]p. (AFOSR-J960) (AF EOAR-62-35) AD 415974 Unclassified

Also published in Ann. Scuola Norm. Super. Pisa, Series 3, v. 16: 327-333, 1962.

It is well known that every open Riemann surface is a Stein manifold. But no proof has so far appeared of the corresponding statement for complex space of dimension one (with arbitrary non-normal singularities), that every (reduced) complex space of dimension one, which has no compact irreducible components, is a Stein space. The object of the present paper is to give a proof of the following theorem on complex spaces, of which the statement made above is a particular case in view of the fact that every normal complex space of dimension one is nonsingular: A (reduced) complex space X is a Stein space if and only if its normalization X^* is a Stein space.

2362

Pisa U. Inst. of Aeronautics (Italy).

LINEARIZED SUPERSONIC FLOW OF AN AXISYMMETRIC JET IN A SUPERSONIC STREAM, by E. Pistolesi and M. Marini. Mar. 1962 [28]p. incl. diagrs. (Technical rept. no. 2) (AFOSR-2792) (AF 61(052)209) AD 276589 Unclassified

In a previous paper (see item no. 2253, Vol. V) the supersonic flow in a jet was studied according to a method which involved the use of particular singularities called pseudosources. A detailed development of the method is presented and the jet boundary is calculated with more complete results than with other methods.

2363

Pisa U. Inst. of Physiology,(Italy).

ACTIVITY OF SINGLE UNITS IN THE PRIMARY OPTIC CORTEX IN THE UNANESTHETIZED RABBIT DURING VISUAL ACOUSTIC, OLFACTORY AND PAINFUL STIMULATION, by T. Lömo and A. Mollica. [1962] [35]p. incl. illus. diagrs. refs. (AFOSR-2827) (AF 61-(053)107) AD 632118 Unclassified

Also published in Arch. Ital. Biol., v. 100: 90-120, Jan. 1962.

The effects of natural stimuli on the discharge of single units of the primary optic cortex have been studied in rabbits with intact nervous systems, and without anesthesia or curare. Of the units recorded in this area, 73% did not alter their discharge during intermittent luminous stimulation. Nine per cent gave variable responses, while 18% were definitely influenced. Not only the units influenced by the specific stimuli, but also the uninfluenced ones, could be clearly modified by the application of nonspecific stimuli of acoustic or painful type. These stimuli are effective even if applied on their own in the dark and can often sensitize to light-flashed units which cannot normaliy be influenced in this way. The effects of the nonspecific stimuli are not linked to the orienting reflex. Olfactory stimuli, by contrast, have little effect even when they produce intense behavioral effects. The introduction of barbiturates in sub-anesthetic doses produces an increase in unitary activity, during which the effects of the nonspecific stimuli can still be seen; later, the discharges disappear or become deeply depressed. After the application of strychnine to the primary optic cortex, in doses such as to produce isolated convulsive waves in the electrocorticogram, one can still record unitary discharges which are uninfluenced by light-flashes. The unitary responses produced by luminous stimuli at low frequency can be recorded over long periods and remain unchanged for several hours. Only when the animal is restless and shows intense spontaneous motor activity, do the unitary discharges appear temporarily inhibited. The somatic and negative mechanisms which might give rise to the observed effects have been examined. The hypothesis is put forward that those elements of the optic cortex which are refractory to specific stimuli possess, in whole or in part, special associative functions.

2364

Pisa U. Inst. of Physiology (Italy).

ROLE OF THE PUPIL IN CHANGES IN EVOKED RESPONSES ALONG THE VISUAL PATHWAYS, by J. Affanni, M. Mancia, and F. L. Marchiafava. [1962] [10]p. incl. illus. refs. (AFOSR-2882) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 405505 Unclassified

Also published in Arch. Ital. Biol., v. 100: 287-296, June 5, 1962.

This work is concerned with the role played by the pupils in changes in evoked potentials recorded in the optic tract, lateral geniculate body and visual cortex of cerveau isolé cats, following repetitive photic stimulation and electrical activation of the mesencephalic reticular system. In cerveau isolé cats, an extreme myosis produced either spontaneously, or by repetitive photic stimulation, was always associated with a reduction and disappearance of potentials evoked along the visual pathways. Stimulation of the mesencephalic reticular formation produced a reappearance and a potentiation of the visual responses of optic tract, lateral geniculate body, and visual cortex. This effect was associated with a

dilatation of the pupils. Permanent dilatation of the pupils followed by application of darkened contact lenses which simulated fissurated pupil prevented the reduction of the visual potentials elicited by prolonged, repetitive photic stimulation. Under these conditions the midbrain reticular stimulation did not influence the responses recorded from the optic tract and the lateral geniculate body. Responses of the visual cortex were instead often depressed. These results suggest that variation of pupils size plays a major role in the phenomena referred to as visual habituation and dishabituation.

2365

Pisa U. Inst. of Physiology (Italy).

ENHANCEMENT OF EEG SYNCHRONY IN THE ACUTE CERVEAU ISOLÉ, by E. Bizzi and W. A. Spencer [1962] [14]p. incl. illus. tables, refs. (AFOSR-2805) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 632117 Unclassified

Also published in Arch. Ital. Biol., v. 100: 234-247, Mar. 1962.

The effects of reversible functional visual deafferentation produced by retinal ischemia and irreversible olfactory deafferentation have been studied in acute post-collicular cerveau isolé preparations which showed interspindle lulls characterized by low voltage fast activity. Visual deafferentation was found to produce a generalized increase in cortical synchrony, but olfactory deafferentation failed to produce anything more than temporary changes in EEG pattern. The increase in EEG synchrony produced by retinal ischemia characteristically appeared after 1 - 3 min, was fully reversible, and was not evident as a replacement of low voltage fast activity during interspindle lulls by slow waves. The effects of retinal ischemia can be assigned to the withdrawal of tonic retinal impulses for the following reasons: (a) the effects were not accompanied by any alterations in EKG or blood pressure; (b) the effects were duplicated by optic nerve ligation; and (c) ocular compression following optic nerve ligation failed to produce any further change. Pentothal, when administered intravenously following either single or combined visual and olfactory deafferentation, always produced a further increase in EEG synchrony. These data suggest that the acute post-collicular cerveau isolé possesses tonically active desynchronizing structures which are reflexly driven by visual impulses. Possible mechanisms underlying this activity are discussed, and their relationship to the activating potentialities of the chronic cerveau isolé are suggested.

2366

Pisa U. [Inst. of Physiology] (Italy).

RESEARCH ON RELATIONS OF BRAIN STEM RETICULAR FORMATION TO ANIMAL BEHAVIOR, by G. Moruzzi. Final technical rept. Dec. 15, 1956-June 14, 1962. June 15, 1962. 11p. incl. refs. (AFOSR-4171) (AF 61(052)107) AD 404986 Unclassified

This report covers the regulation of the inflow of retinal impulses; pyramidal influences on dorsal columns nuclei; relationships between vision of polarized light and orientation in spiders; neurophysiological investigation on the mobbing reaction in the chaffinch; ocular behavior in the midpontine pretrigeminal cat; relationships between electrophysiological activity and behavior during the episodes of low voltage fast sleep in the intact cat; central effects of retinal blackout; and the tonic discharge of the retina.

2367

Pisa U. Inst. of Physiology (Italy).

PALPEBRAL ASYMMETRY IN THE DARK ADAPTED OWL (ATHENE NOCTUA) FOLLOWING UNILATERAL IRREVERSIBLE VISUAL DEAFFERENTATION, by G. Berlucchi and P. Strata. [1962] [11]p. incl. illus. refs. (AFOSR-4178) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 637120 Unclassified

Also published in Arch. Ital. Biol., v. 100: 248-258, Mar. 1962.

Unilateral visual deafferentation was obtained in the owl by photocoagulating the optic papilla or by destroying the retina with ischemia. The unilateral retinal inactivation is followed by palpebral asymmetry, which becomes evident when the bird falls asleep or during arousal produced by light sensory stimulations. The asymmetrical behavior of the eyelids consists of the earlier closure and the delayed opening of the blinded eye respectively at the onset and at the end of the sleep. These phenomena are attributed to hypotonia of the levator palpebrae superioris and depressor palpebrae inferioris muscles in the blinded eye. This hypotonia is due to the lack of a tonic discharge, normally arising from the retina. Since the palpebral asymmetry is present also in complete darkness, it is concluded that the retinal dark-discharge drives reflex the palpebral motoneurons involved in the opening of the eye.

2368

Pisa U. Inst. of Physiology (Italy).

A METHOD FOR THE QUANTIFICATION OF TONIC ACTIVITY IN THE NERVOUS SYSTEM, by A. Arduini and L. R. Pinneo. [1962] [10]p. incl. diagrs. (AFOSR-4242) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Also published in Arch. Ital. Biol., v. 100: 415-424, Oct. 1962.

A method has been described for quantitative analysis of tonic activity in the nervous system. The parameter of measurement in the average power of the system, which is proportional to the mean square ($V\text{-rms}^2$) voltage of the signal minus the mean square of the noise; the average power is also proportional to the number of impulses of the system. Limitations of the system are: (a) measurement is possible only in a system that

involves discrete pulses, such as fiber tracts, and (b) it does not account for differences in fiber size or wave form which might disproportionately affect the total potential. Mathematical formulations basic to the assumption of a linear transformation from number of pulses to the rings or ms voltage were given and an alternate technique for measuring average voltage described.

2369

Pisa U. Inst. of Physiology (Italy).

PROPERTIES OF THE RETINA IN RESPONSE TO STEADY ILLUMINATION , by A. Arduini and L. R. Pinneo. [1962] [24]p. incl. illus. diagrs. refs. (AFOSR-4243) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Also published in Arch. Ital. Biol., v. 100: 425-448, Oct. 1962.

In 85% of nembutal-anesthetized cats tested, tonic activity in the retina as measured by gross electrodes in the optic chiasm, decreased with increases in the level of steady illumination. The change in activity is related to the intensity of illumination by an inverse power function. In 15% of nembutal-anesthetized cats tested, the tonic activity in the retina is enhanced when the level of steady illumination is raised. The change in activity in these animals is always related to the dark discharge just prior to stimulation. In these experiments when the signal-to-noise (S/N) ratio was below 1.45, there was an increase with light; in the same animals, if, the S/N ratio of the dark discharge was above 1.45, there was a decrease with light. These results were also found in unanesthetized pre-trigeminal preparations and in pre-collicular decerebrate preparations. In the pre-trigeminal cats with S/N ratios below the reversal threshold, it was found that this level could be increased by repeated light stimulation, reversible deafferentation by retinal ischemia due to increased intraocular pressure, or by injections of small doses of nembutal. As in the nembutal preparations, when the S/N ratio was again greater than the reversal (2.50 in the pre-trigeminal preparation), the effect of light was to reduce the level of tonic activity. Semi-microelectrode controls confirmed the results obtained with gross electrodes. This substantiates the hypothesis that the tonic acitivity of the retina as measured in this study was directly related to the number of elements firing. The conclusion is reached that tonic retinal activity is functionally related to several aspects of the visual process. Possible mechanisms of control of tonic activity in the retina are discussed.

2370

Pisa U. Inst. of Physiology (Italy).

DIFFERENCES IN CORTICAL ACTIVITY DURING DESYNCHRONIZED SLEEP AND AROUSAL, by A. Arduini. [1962] [3]p. incl. refs. (AFOSR-J195) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 400182 Unclassified

Also published in Proc. Internat'l. Union of Physiological Sciences; Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 1 (Pt. 1): 464-466, 1962.

Preliminary investigations lead to the surprising conclusion that, at least as far as 'spontaneous' pyramidal activity is concerned, the stage of deep sleep characterized by fast EEG patterns and by muscular relaxation cannot be easily distinguished from the aroused state in which the EEG is also represented by fast low voltage waves and by a strong tonus of the cervical muscles. In both instances the pyramidal tract fibers appear to be considerably more active than in the light sleep state. These findings do not necessarily imply that the mechanisms of EEG desynchronization are the same for deep sleep and arousal. It is clear, moreover, that the distribution of the activity among the different phyramidal fibers is likely to be greatly different during arousal and during fast sleep. It is surprising, nevertheless, that the overall activity of the main efferent channel arising from the cerebral cortex is so high during a condition characterized, behaviorally, by deep sleep.

2371

Pisa U. [Inst. of Physiology] (Italy).

[PYRAMIDAL ACTIVITY IN THE CAT DURING WAKEFULNESS AND PHYSIOLOGICAL SLEEP] Attivita' piramidale nel gatto durante la veglia ed il sonno fisiologico, by A. Arduini, G. Berlucchi, and P. Strata. [1962] [3]p. (AFOSR-J1326) (AF 61(052)107) AD 427980; AD 632617 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 38: 1607-1609, 1962.

The recent descriptions of a stage of sleep in which the EEG resembles that of the waking animal has posed some problems on the behavior of cortical neurons during sleep. These experiments were made with electrodes implanted in the pyramidal tract at the level mesencephalic or bulbar, and concurrent measurements of the EEG and electromyogram of the neck muscles. It was concluded that in the phase of sleep with rapid EEG, similar to that in waking, the pyramidal neurons, at least those of the reticular, showed a frequency of firing that did not exceed that of the waking state. A discussion of the significance of these findings will be published elsewhere.

2372

Pisa U. Inst. of Physiology (Italy).

SOMATOPIC ORGANIZATION OF THE POSTURAL RESPONSES TO STIMULATION AND DESTRUCTION OF THE CAUDAL PART OF THE FASTIGIAL NUCLEUS, by O. Pompeiano. [1962] [13]p. incl. illus. diagrs. refs. [AF 61(052)107] Unclassified

Published in Arch. Ital. Biol., v. 100: 259-271, Mar. 1962.

The influence of localized destruction of the caudal part of the fastigial nucleus on cat's decerebrate rigidity was studied. Lesions of the rostral part of the caudal third of the fastigial nucleus yielded a striking decrease of extensor rigidity in the contralateral forelimb, while the

hindlimbs did not show any postural asymmetry. On the other hand, when the lesion involved only the extreme caudal pole of the fastigial nucleus, the ensuing atonia was limited to the contralateral hindlimb, while the forelimbs did not show any postural asymmetry. If the same nuclear regions were stimulated with threshold stimuli, responses localized to the forelimb or to the hindlimb, but opposite in sign, were obtained. The somatotopic organization of the postural responses to localized stimulation or destruction of the caudal part of the fastigial nucleus is in agreement with anatomical data on the termination within the contralateral Deiters nucleus of the efferent fibers arising from these fastigial regions. The conclusion is drawn that the tonic facilitatory influence exerted by the caudal part of the fastigial nucleus on the extensor mechanisms of the contralateral side of the body is mediated via the Deiters nucleus.

2373

Pittsburgh U. [Dept. of Chemistry] Pa.

STRUCTURAL FACTORS IN THE FORMATION OF CLATHRATE HYDRATES, by G. A. Jeffrey. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-2152) (AF 49(638)456) AD 424399 Unclassified

Also published in Dechema-Monographen, v. 47: 849-860, 1962.

The clathrate hydrates form a well-defined class of crystalline compounds in which hydrogen-bonded water molecules form a 'host' structure enclosing hydrophobic or partially hydrophobic molecules or ions as "guests" in a cage type of molecular complex. In common with most molecular complexes they have potential or actual use as intermediates in separation and purification processes. At present, 2 chemically distinct series of compounds of this general class are known. These are the gas hydrates and the alkylated quaternary ammonium salt hydrates with some related peralkylated analogues. These compounds have a common structural feature in the $H_{40}O_{20}$ pentagonal dodecahedron, which is the basic unit of coordination of their water structure. The relationship between these structures and the factors which appear to control their formation is discussed.

2374

Pittsburgh U. [Dept. of Chemistry] Pa.

STRUCTURE OF CRYSTALLINE HYDRATES OF ORGANIC MOLECULES AND IONS, by G. A. Jeffrey. Final rept. Aug. 31, 1962 [3]p. (AFOSR-3486) (AF 49(638)456) AD 288129 Unclassified

This report lists 7 journal articles and 5 papers presented at meetings, which describe the work done under the contract.

2375

Pittsburgh U. [Dept. of Chemistry] Pa.

POLYHEDRAL CLATHRATE HYDRATES. III. STRUCTURE OF THE TETRA N-BUTYL AMMONIUM BENZOATE HYDRATE, by M. Bonamico, G. A. Jeffrey, and R. K. McMullan. [1962] [13]p. incl. illus. diagrs. tables. [AF 49(638)456] Unclassified

Published in Jour. Chem. Phys., v. 37: 2219-2231, Nov. 15, 1962.

The compound $(n\text{-}C_4H_9)_4N \cdot C_6H_5COO \cdot 39\ 1/2H_2O$ forms tetragonal crystals with 4 molecules in the unit cell. The water structure is a hydrogen-bonded clathrate framework, in the cavities of which are located the tetra alkyl ammonium cations. The oxygen atoms of the benzoate anions are hydrogen-bonded to the water framework and form part of the polyhedral structure. This structure contains 10 pentagonal dodecahedra, 16 tetrakaidecahedra, and 4 pentakaidecahedra per unit cell. The 20 larger polyhedra are occupied by the 16 alkyl and 4 benzyl groups with a statistical disorder over 2 sets of equivalent cation and anion positions. There is evidence of additional hydrogen-bonded water inside some of the dodecahedra which are distorted due to the presence of the ions. The clathrate framework is iso-structural with that of other salts in this series, which have a very similar tetragonal lattice but differ in containing 5 tetra n-butyl ammonium salt molecules per unit cell.

2376

Pittsburgh U. [Dept. of Chemistry] Pa.

POLYHEDRAL CLATHRATE HYDRATES. IV. THE STRUCTURE OF THE TRI N-BUTYL SULFONIUM FLUORIDE HYDRATE, by G. A. Jeffrey and R. M. McMullan. [1962] [9]p. incl. illus. diagrs. tables, refs. [AF 49(638)456] Unclassified

Published in Jour. Chem. Phys., v. 37: 2231-2239, Nov. 15, 1962.

The preparation and crystal structure of $(n\text{-}C_4H_9)_3S^+F^- \cdot 2OH_2O$ is reported. This hydrate is isostructural with the chlorine gas hydrate, $6Cl_2 \cdot 46H_2O$, having a pseudo body-centered arrangement of $H_{40}O_{20}$ pentagonal dodecahedra in a cubic unit cell of approximately 12A edge. The cations occupy large voids formed by the tetrakaicahedra in the structure and are statistically disordered. The water structure is distorted as compared with the idealized polyhedral framework and there is evidence that the pentagonal dodecahedra may be occupied by a water molecule or a fluoride ion. (Contractor's abstract)

2377

Pittsburgh U. Dept. of Chemistry, Pa.

THE PHOTOINITIATED ARYLATION OF TRIVALENT PHOSPHORUS COMPOUNDS, by J. B. Plumb and C. E. Griffin. [1962] [2]p. (AFOSR-J440) (AF AFOSR-62-48) AD 408601 Unclassified

Also published in Jour. Org. Chem., v. 27: 4711-4712, Dec. 1962.

As part of an effort to develop new procedures for the formation of the aryl-phosphorus bond, the photolysis of aromatic iodo compounds in the presence of triphenylphosphine and several trialkyl phosphites was examined. It was found that the processes constituted convenient

and apparently general one-step syntheses of the corresponding triphenyl(aryl)phosphonium iodides and dialkyl arylphosphonates. In the triphenyl-phosphine reaction, all indications point to a non-chain reaction. Without careful choice of conditions, the alkyl iodide undergoes an Arbuzov reaction with the trialkyl phosphite to form dialkyl alkylphosphonate at the expense of the phenylphosphonate. When the above reaction was conducted at 50°, only 3.9% of the phenylation product was obtained; the remainder of the phosphite was converted quantitatively to dimethyl methylphosphonate. In accord with its mechanism, the Arbuzov process was expected to be less important with the higher trialkyl phosphites.

2378

Pittsburgh U. [Dept. of Chemistry] Pa.

MAGNETIC CHARACTERISTICS OF LAVES PHASES CONTAINING LANTHANIDE METALS COMBINED WITH NICKEL, by E. A. Skrabek and W. E. Wallace. [1962] [2]p. incl. diagr. table, refs. (AFOSR-64-1513) (AF AFOSR-63-187) AD 446361 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1356-1357, Apr. 1963.

Studies have been made of the series of compounds represented by the formula ANi_2, where A is Y, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, and Lu. These compounds are all isostructural, possessing the $MgCu_2$ structure. Nine of the compounds exhibit magnetic ordering at temperatures ranging from 8°K to 90°K. The Y, Ce, and Lu remain paramagnetic down to liquid helium temperatures. YNi_2 and $LuNi_2$ exhibit Pauli paramagnetism from 4° to 300°K suggesting that Ni has a filled 3d shell and is not carrying a moment in these phases. $CeNi_2$ also exhibits Pauli paramagnetism, which implies that Ce has been ionized to the quadripositive state. The measured saturation moment extrapolated to 0°K is in good agreement with the value expected if Ni is nonmagnetic and the lanthanide component carries the moment of the free tripositive ion in the case of $GdNi_2$, but is in poor agreement for the 8 other compounds which order magnetically. For all except $SmNi_2$ the observed moment is less than that of the free ion, the discrepancy ranging from 78% for $PrNi_2$ to 28% for $HoNi_2$. The low moment is attributed to the quenching effect of the crystal field, but the possibility cannot be excluded that these are not simple ferromagnets. The moment for $SmNi_2$ is 6.3 μ_B, as compared with 0.71 μ_B for the ground state free tripositive ion (L-S coupling). The origin of the high moment for this compound is not understood. Its magnitude can be rationalized in terms of a change to L - S coupling.

2379

Pittsburgh U. [Dept. of Physics] Pa.

LINE STRENGTHS AND WIDTHS IN HYDROGEN IODIDE, by G. Ameer and W. Benesch. [1962] [4]p. incl. diagrs. table, refs. [AF 18(600)986] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Abstract published in Bull. Amer. Phys. Soc. Series II, v. 7: 271, Apr. 23, 1962 (Title varies)

Published in Jour. Chem. Phys., v. 37: 2699-2702, Dec. 1, 1962.

Measurements on 13 lines in the hydrogen iodide fundamental vibration-rotation have yielded a set of line strengths of considerable accuracy. From these strengths a total band intensity of 0.37 cm^{-2} atm^{-1} at 300°K has been computed, as well as a value for the vibration-rotation interaction parameter θ which is found to be -5. Both of these figures indicate that the effective charge of this molecule is remarkably small, which fact is reflected in a great dominance of the R branch over the P branch. Using the line strengths as input data, linewidths have been computed from equivalent width measurements. Finally, the linewidths have been converted to optical collision cross sections. The J dependence of the linewidths and the collision cross sections is not typified by the other hydrogen halides. The usual resonance peak is absent and a lower limiting value seems to be reached by $|m| = 3$. Furthermore, the collision cross sections for the lines of higher J are much larger than might be inferred from the other hydrogen halides. (Contractor's abstract)

2380

Pittsburgh U. [Dept. of Sociology] Pa.

ANALYSIS OF COLD WAR OUTCOMES WHICH THE MAJOR POWERS ARE SEEN AS DESIRING MOST AND LEAST, by S. E. Shively. Jan. 1962, 58p. incl. tables. (AFOSR-1851) (AF 49(638)1116) AD 270730 Unclassified

A study has been conducted to investigate the final outcomes of the Cold War which are desired (and not desired) by the Soviet Union, the United States, Communist China and the respondent's own country. A sample of legislators and students from France, Germany, India, Japan, Spain, Brazil, and Finland were asked questions about these most and least desired outcomes. The major findings are: (1) The respondents demonstrate that they believe there is a high positive correlation regarding the outcomes of the Cold War which are most desired between their own country and the United States; (2) Similarly, the respondents believe there is a high positive correlation between their own country and the United States on the outcomes which are least desired; (3) High positive correlation also exists in respect to the outcomes most and least desired between the Soviet Union and Communist China; (4) Negative correlations exist in reference to most and least desired outcomes between the respondent's own country and the Soviet Union, the respondent's own country and Communist China, the United States and the Soviet Union, and the United States and Communist China; (5) The respondent's own country is viewed as being the most desirous of world-wide disarmament; (6) The United States is seen as most desiring a reconciliation between itself and the Soviet Union; (7) Both the Soviet Union and Communist China are believed to most desire the acceptance of Communism by non-Communist nations; (8) The respondent's believe their own country

least desires World War III; (9) The United States is seen as least desiring an internal economic depression; (10) The Soviet Union is believed to least desire an economic crisis in the Soviet Union; and (11) Communist China is seen as least desiring an alliance between the United States and the Soviet Union against Communist China. (Contractor's abstract, modified)

2381

Pittsburgh U. [Dept. of Sociology] Pa.

EXPLORATIONS IN PERSONAL AND NATIONAL EFFICACY, by D. M. Walton. Jan. 1962, 37p. incl. tables. (AFOSR-1852) (AF 49(638)1116) AD 270731 Unclassified

Legislators and students from Brazil, Finland, France, Germany, India, Japan, and Spain were interviewed about their perception of their own efficacy, the efficacy of their own nation and that of an additional list of nations and groups of nations. A fairly consistent agreement is found in degree of influence that respondents attribute to themselves, and in the degree of influence that is attributed to the various nations, or groups of nations. The legislators generally see themselves as being more influential than the students see themselves. The United States and the Soviet Union are consistently ranked as being influential while the Latin American Nations are consistently ranked low.

2382

Pittsburgh U. [Dept. of Sociology] Pa.

ANTICIPATED CHANGES OF NON-COMMUNIST NATIONS TOWARD COMMUNISM, by D. M. Walton. Jan. 1962, 38p. incl. tables. (AFOSR-1914) (AF 49(638)-1116) AD 271902 Unclassified

This report deals with propensities on the part of nations to become communistic in the future either voluntarily or by force. The respondents, students and legislators from Brazil, Finland, France, Germany, India, Japan and Spain, were interviewed about general likelihood and desirability of such changes in the United States and their own country. The respondents were then provided with a list of non-Communist nations and asked to state which one of the countries listed might change in either of the 2 ways mentioned. A great degree of agreement is found for all subject groups on all of these likely transitions. Voluntary change is seen as being more likely than a change brought about by force. One group of nations consistently seen as likely to change to communism either voluntarily or by force includes Cuba, the Republic of Congo (ex-Belgium), Indonesia, Italy, Ghana, Guinea, United Arab Republic and Iraq. Another group which is seen as being unlikely to change includes Canada, Norway, Great Britain, Israel, Belgium, West Germany, Dahomey and Gabon.

2383

Pittsburgh U. [Dept. of Sociology] Pa.

PERCEIVED ECONOMIC AND MILITARY STRENGTH OF NATIONS, by S. E. Shively. Feb. 1962 [53]p. incl. tables. (AFOSR-1915) (AF 49(638)1116) AD 272036 Unclassified

The distribution of economic and military power in the world at the present time and the predicted power distribution 5 yr hence were investigated. Samples of legislators and students from 7 countries were interviewed. The major findings are that the United States is pictured as being the strongest nation in the world at the present time in respect to economic strength, and it is expected to also remain strongest 5 yr from now; the Soviet Union is believed to be the second strongest nation at the present time with respect to economic strength and it is expected to also be the second strongest during the next 5 yr; however, the United States is pictured as relatively decreasing in its economic lead during the next 5 yr. The students place the Soviet Union as the strongest military power, both at the present time and 5 yr hence, and the United States as the second strongest. Legislators, on the other hand, tend to believe that the United States is the strongest military power both at the present time and in 5 yr, the Soviet Union being the second strongest.

2384

Pittsburgh U. [Dept. of Sociology] Pa.

ANTICIPATED CHANGES IN COMMUNIST NATIONS, by S. E. Shively and M. Gannon. Mar. 1962 [30]p. incl. tables. (AFOSR-2317) (AF 49(638)1116) Unclassified

To investigate possible changes of certain Communist nations away from Communism, the opinions of 616 parliamentarians and 700 students from France, Germany, India, Japan, Spain Brazil and Finland were studied. The major findings may be expressed in the following statements: (1) It is felt that Poland, East Germany, Hungary and Czechoslovakia — in that order — are more likely to change away from Communism than are Bulgaria, North Viet-Nam, North Korea, Albania and Rumania. (2) It is believed that change in Czechoslovakia, although more likely than in 5 of the above nations, is not as likely to occur as in Poland, East Germany and Hungary; (3) The expectancy of political re-alignments away from Communism taking place in the next 5 yr in currently Communistic countries is generally higher than comparable expectations that non-Communistic nations will turn toward Communism; (4) In general, it is believed that if a movement away from Communism occurs, it is more likely to take the form of anti-Communist revolutions than of the acceptance of national Communism or the institution of a democratic government; (5) The rank order correlations between the 9 Communist countries changing through anti-Communistic revolutions, development of national Communism and the institution of a democratic form of government are quite high; this points to considerable agreement concerning some type of change away from Communism in some of the nations under study; (6) The Indian respondents consistently fail to recognize the likelihood that Communist nations are liable to change away from Communism; further, they do not foresee changes in non-Communist countries toward Communism; and (7) In general, students anticipate greater changes than do the legislators. (Contractor's abstract, modified)

2385

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

MAGNITUDE OF EXCHANGE INTERACTIONS IN GADOLINIUM, by D. A. Goodings. [1962] [20]p. incl. diagr. table, refs. (AFOSR-2537) (AF 49(638)323) Unclassified

Also published in Phys. Rev., v. 127: 1532-1536, Sept 1, 1962.

The effective nearest-neighbor exchange interaction J in gadolinium can be deduced from experiment in 2 ways. From a high temperature expansion of the susceptibility and the measured value of the Curie temperature T_c one obtains J = 2.9°K, while from the low temperature magnetization curve and simple spin-wave theory one finds J = 1.8°K. In order to clarify the reason for this discrepancy, the low temperature spin-wave problem has been analyzed in detail. Contributions to the magnetization from 2 different spin-wave modes were evaluated up to order $T^{7/2}$ and important corrections arising from zone boundary effects were included. The detailed analysis yields a slightly improved low temperature value, J = 2.1°K. It is also demonstrated that the magnetization follows a $T^{3/2}$ law very closely from low temperatures up to about 0.8 T_c because of a complicated cancellation of the higher order effects. Finally it is shown qualitatively that the remaining difference between the high and low temperature J values can probably be explained by the effect of interactions beyond nearest neighbors and it is suggested that these are on average more antiferromagnetic than ferromagnetic.

2386

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

A NUCLEAR QUADRUPOLE RESONANCE AND X-RAY STUDY OF THE CRYSTAL STRUCTURE OF 2, 5-DICHLOROANILINE, by T. Sakurai, M. Sundaralingam, and G. A. Jeffrey. [1962] [37]p. incl. diagrs. tables, refs. (AFOSR-2540) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)323 and National Science Foundation) Unclassified

Also published in Acta Cryst., v. 16: 354-363, May 10, 1963.

The crystal structure of 2, 5-dichloroaniline, $C_6H_3Cl_2NH_2$ has been determined by the combined application of nuclear quadrupole resonance and x-ray diffraction. The molecule is planar, except for the nitrogen which deviates slightly, by 0.06A. The benzene ring is slightly deformed from the regular hexagon and the observed bond lengths agree well with the result of a simple molecular orbital calculation. There is no hydrogen bonding in the structure. The shortest intermolecular Cl...Cl distance, 3.37A, is shorter than the usually quoted van der Waals distance of 3.6A.

2387

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

A NUCLEAR QUADRUPOLE RESONANCE AND X-RAY STUDY OF THE CRYSTAL STRUCTURE OF PENTACHLOROPHENOL, by T. Sakurai. [1962] 38p. incl. diagrs. tables, refs. (AFOSR-2541) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)323 and National Science Foundation) AD 276140 Unclassified

Also published in Acta Cryst., v. 15: 1164-1173, 1962

The crystal structure of the pentachlorophenol, C_6Cl_5OH, was solved by the combined application of nuclear quadrupole resonance and x-ray diffraction. The molecules are linked by chains of hydrogen-bonds with a configuration similar to that in tetrachlorohydroquinone $C_6Cl_4(OH)_2$. The nuclear quadrupole resonance of one of the ortho chlorine atoms is specially affected by the intermolecular interaction. This interaction is attributed to the proton on the OH group of the adjacent molecule, and the existence of O-H$\begin{matrix}\cdot\cdot O \\ \cdot\cdot Cl\end{matrix}$ bifurcated hydrogen bonds with bond lengths O-H..O = 2.97A and O-H..Cl = 3.28A is inferred. During the phase determination, a pseudo solution was obtained, which was unusually close to the true solution. The relation between these 2 solutions is discussed.

2388

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

APPLICATIONS OF NUCLEAR QUADRUPOLE RESONANCE, by G. A. Jeffrey and T. Sakurai. [1962] [67]p. incl. diagrs. tables, refs. (AFOSR-2542) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)323] and National Science Foundation) AD 276141 Unclassified

Also published in Prog. Solid State Chem., v. 1: 380-416, 1964.

Radio-frequency nuclear resonance has provided the chemist with 2 powerful techniques for investigating chemical problems. In both nuclear magnetic resonance and nuclear quadrupole resonance, the structure and behavior of molecules can be explored using the nucleus effectively as a test probe. In contrast to nmr, nqr depends primarily upon interaction between the nuclear quadrupole moment and the electric field gradients attributable to the charge distribution in the solid. Therefore many problems concerned with the electronic structure in crystalline solids can be explored by this method. Information pertaining to the nuclear quadrupole interaction of atoms in gases can be obtained by other methods, such as microwave spectroscopy, but not by nqr. The method pertains specifically to the solid state, and may be expected to develop into an increasingly effective means of investigation in that area. In principle, it is applicable to all atoms with nuclear spin greater than or equal to unity. In practice, the nuclear quadrupole moment and natural abundancy and the chemical bonds associated with it must have an appreciable measure of p-orbital character in order to obtain a suitably large field gradient.

2389

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

MAGNETIC FIELD DEPENDENCE OF THERMODYNAMIC PROPERTIES OF ANTIFERROMAGNETS; ADIABATIC MAGNETIZATION, by R. J. Joenk, Jr. [1962] [48]p. incl. diagrs. tables, refs. (AFOSR-2752) (Also bound with its AFOSR-3362; AD 283065) [AF 49(638)323] Unclassified

Also published in Phys. Rev., v. 128: 1634-1645, Nov. 15, 1962. (AFOSR-J1570; AD 426562)

The thermodynamic properties of cubic or uniaxial antiferromagnets are examined using spin wave theory. The specific heat, magnetization and parallel susceptibility are shown to be exponentially increasing functions of applied field for values of H_0 less than the critical spin-flopping field. Since this field dependence suggests than an antiferromagnet can be cooled by the adiabatic application of a magnetic field, the theory of adiabatic magnetization is investigated. Field-dependent nuclear spin effects are evaluated on an effective field model by perturbation theory and are included in the analysis. It is found that when spin wave effects are dominant, cooling should be observed; at lower temperatures, when nuclear effects are non-negligible, either cooling or heating may be observed, depending on the initial temperature and final value of the magnetic field. The dependence of the cooling on the physical parameters of the antiferromagnet is discussed and detailed calculations are made for MnF_2.

2390

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

STUDIES OF POLARON MOTION. PART III. THE HALL MOBILITY OF THE SMALL POLARON. by L. Friedman and T. Holstein. [1962] 102p. incl. diagrs. (AFOSR-3042) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)323 and Westinghouse Electric Corp) Unclassified

Also published in Ann. Phys., v. 21: 494-549, Mar. 1963. (AFOSR-J1571; AD 427639)

The one-dimensional molecular crystal model of polaron motion is developed to consider the existence of a Hall effect. The treatment is confined to the case for which the electronic overlap term of the total Hamiltonian is a small perturbation. In zeroth order - i.e., in the absence of this term - the electron is localized at a given site. The vibrational state of the system is specified by a set of quantum numbers, Nk, giving the degree of excitation of each vibrational mode. The existence of a nonvanishing electronic bandwidth then gives rise to transitions to neighboring sites. Of principal interest in the present paper is the high temperature regime where polaron motion is predominantly between neighboring sites. Although the lowest order jump rate is adequate in considering the polaron drift mobility, higher order processes, involving the occupation of (at least) 3 sites, must be taken into account in treating the Hall effect.

2391

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

THEORETICAL PROBLEMS IN FERRO- AND ANTIFERROMAGNETISM, by R. J. Joenk, Jr. Doctoral thesis, 1962, 85p. incl. diagrs. tables, refs. (AFOSR-3362) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)323 and National Science Foundation) AD 283065 Unclassified

This report is divided into 3 sections all of which have been reviewed separately: (see item no. 2277, Vol. V; item no. 2389, Vol. VI; and item no. 2398, Vol. VI).

2392

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

MAGNETIC AND STRUCTURE PROPERTIES OF SOLIDS AND SOLUTIONS, by F. Keffer, J. H. Andersen and T. Holstein. Final rept. [1962] [13]p. (AFOSR-4318 pt. 1]) (AF 49(638)323) AD 292905 Unclassified

The general aim of this work has been to increase the understanding of the relationship between the electron and magnetic properties of solids and their crystal structures. The work has been both experimental and theoretical. Basic experimental techniques have included nuclear quadrupole resonance, optical absorption, and electron spin resonance.

2393

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

MAGNETIC AND STRUCTURE PROPERTIES OF SOLIDS AND SOLUTIONS, by F. Keffer, J. H. Andersen, and T. Holstein. Final rept. [1962] [5]p. (AFOSR-4318, pt. 2) (AF 49(638)323) AD 428349 Unclassified

A brief summary of additional results, as reported in publications is given; some of the subject areas covered include: thermodynamics, ferromagnetism, ion temperature research, anisotropy, and titanium and quartz crystals.

2394

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

TEMPERATURE DEPENDENCE OF THE ZEEMAN EFFECT IN THE NUCLEAR QUADRUPOLE RESONANCE IN CHLORANIL, by C. B. Richardson. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-J1568) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)323] and National Science Foundation) AD 427659 Unclassified

Also published in Jour. Chem. Phys., v. 38: 510-515, Jan. 15, 1963.

The nuclear quadrupole resonance of Cl^{35} and its Zeeman effect have been observed in chloranil between 78° and 373°K. Effects of thermal expansion appear negligible hence the Bayer theory is used with the measured temperature dependence of the pure quadrupole frequencies and the field-gradient asymmetries to yield room-temperature rigid-body libration amplitudes of $\langle \theta_x^2 \rangle = 18 \times 10^{-3}$ rad^2, $\langle \theta_y^2 \rangle = \langle \theta_z^2 \rangle = 0$, where x is along the molecular normal. A broad phase transition centered near 100°K is examined. The results suggest that the potential well $V(\theta_x)$ has a double minimum and that the transition occurs when the molecules have sufficient torsional energy to override the barrier.

2395

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

COVALENT BOND ASYMMETRIES FROM ZEEMAN-SPLIT NQR, by V. Rehn. Sept. 1962 [11]p. incl. diagrs. tables, refs. (AFOSR-J1564) (AF 49(638)323) AD 427658 Unclassified

Also published in Jour. Chem. Phys., v. 38: 749-759, Feb. 1, 1963.

An experimental technique is developed for the measurement of asymmetry parameters in electric quadrupole coupling of nuclei with spin I = 3/2 in covalent bonds in organic single crystals. The theoretical details of Zeeman-split nuclear quadrupole resonance spectra, upon which the technique is based, are examined and found to yield a particularly simple approximate expression for the asymmetry parameter of the electric field gradient tensor, which has been previously shown to be proportional to the double-bond character of the covalent bond. The technique is applicable to atoms bound to a single neighbor in the organic molecule. The limitations of the approximations involved in obtaining the simple formula are examined in detail, and it is found that an order-of-magnitude smaller probable error may be obtained than has been possible with previous geometrical techniques. Correction formulas are presented which may yield still another order-of-magnitude better precision if desired.

Experimental results on the Cl^{35} resonances in para-dichlorobenzene, para-chloroaniline, and 1245 tetrachlorobenzene demonstrate the method, along with verifying the second- and third-order perturbation theoretic results which derive the maximum magnetic field-about 2400 Oe— in which the simple formulas may be used. Other experimental measurements of the asymmetry parameters of C·Cl bonds are tabulated.

2396

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

A NUCLEAR QUADRUPOLE RESONANCE AND X-RAY STUDY OF THE CRYSTAL STRUCTURE OF 2, 5-DICHLOROANILINE, by T. Sakurai, M. Sundaralingam, and G. A. Jeffrey. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-J1565) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)323 and National Science Foundation) AD 426553 Unclassified

Also published in Acta Cryst., v. 16: 354-363, May 10, 1963.

For abstract see item no. 2386, Vol. VI.

2397

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

ADIABATIC MAGNETIZATION OF ANTIFERROMAGNETS, by R. J. Joenk, [Jr.] [1962] [2]p. incl. table. (AFOSR-J1566) (AF 49(638)323) AD 427657 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1097-1098, Apr. 1963.

Spin-wave theory was used to determine the magnetic field dependence of the thermodynamic properties of cubic or uniaxial antiferromagnets at temperatures well below the Néel point. These properties were found to be exponentially increasing functions of applied field for values of H_0 less than the critical spin-flopping field. This field dependence suggests that if spin wave effects are dominant an antiferromagnet can be cooled by adiabatic magnetization in contradistinction to the paramagnetic case of cooling by demagnetization. Both lattice and nuclear effects can alter the situation in a real material and were included in this investigation. The dependence of adiabatic magnetization cooling on the physical quantities characterizing the antiferromagnet is discussed and theoretical temperature changes for several uniaxial antiferromagnets are given. (Contractor's abstract, modified)

2398

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

SECOND ANISOTROPY CONSTANT IN CUBIC FERROMAGNETIC CRYSTALS, by R. J. Joenk, Jr. 1962 [43]p. incl. diagrs. table, refs. (AFOSR-J1567) (Also bound with its AFOSR-3362; AD 283065) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)223 and National Science Foundation) AD 427652 Unclassified

Also published in Phys. Rev., v. 130: 932-938, May 1, 1963.

The second anisotropy constant, K_2, is evaluated at 0°K for cubic, ferromagnetic crystals using 2-particle dipole- and quadrupole-like interactions as perturbations on a molecular field Hamiltonian. In second- and third-order perturbation, the energy denominators are modified to take into account the effect on the molecular field of the exchange interaction of consecutively reversed spins. The expression for $K_2(0)$ is used in conjunction with that for $K_1(0)$ to calculate the values of the pseudodipolar and pseudoquadrupolar coupling constants for iron, cobalt, and nickel. For bcc Fe, $D/J = 0.0793$ and $Q/J = 0.00157$, where $JS = 2.87 \times 10^{-14}$ erg; for fcc

Co, D/J = 0.113 and Q/J = 0.000865, where JS = 2.0 x 10^{-14} erg; and for fcc Ni, D/J = -0.0768 and Q = 0, where JS = 2.5 x 10^{-14} erg, although the application of the model to nickel is not entirely satisfactory. These values are used to predict the size of the third anisotropy constant and the paramagnetic resonance linewidth.

2399

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

ELECTRICAL RESISTIVITY OF FERROMAGNETS AT LOW TEMPERATURES, by D. A. Goodings. [1962] [2]p. incl. diagr. table. (AFOSR-J1568) (AF 49(638)-323) AD 427656 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1370-1371, Apr. 1963.

The contribution to the electrical resistivity of ferromagnetic metals which is associated with the magnetic behavior has been studied theoretically at low temperatures. As in previous theoretical work this resistivity is assumed to be due to scattering of conduction electrons by spin waves through the s-d interaction. An expression valid for a general lattice is presented which is shown to account for the form of the temperature dependence for Fe, Co, Ni, and Gd. However, estimates of the magnitude of the resistivity arising from this interaction indicate that it may be from 1 to 2 orders of magnitude too small to account for the experimental results. (Contractor's abstract)

2400

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

EFFECT OF SURFACE PINNING ON THE MAGNETIZATION OF THIN FILMS, by J. A. Davis and F. Keffer. [1962] [2]p. incl. diagr. (AFOSR-J1569) (AF 49(638)-323) AD 427651 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Also published in Jour. Appl. Phys., v. 34: 1135-1136, Apr. 1963.

The pinning of surface spins introduces an effective gap into the spin-wave spectrum of thin films, causing the magnetization vs temperature curve to lie well above that obtained from use of periodic boundary conditions. The results of detailed calculations are presented for the case of partial surface pinning in a simple cubic lattice, spin 1/2. For films of greater than 6 atomic layers, and for a surface anisotropy field greater than one-tenth the surface exchange field, the magnetization is essentially indistinguishable from the Bloch $T^{3/2}$ curve below $T/T_c \sim 0.2$. This may account for recent measurements by Neugebauer on nickel and by Hoffman on iron. (Contractor's abstract)

2401

Pittsburgh U. Sarah Mellon Scaife radiation Lab., Pa.

MAGNETIC FIELD DEPENDENCE OF THERMODYNAMIC PROPERTIES OF ANTIFERROMAGNETS; ADIABATIC MAGNETIZATION, by R. J. Joenk, [Jr.]. [1962] [12]p. incl. diagrs. table, refs. (AFOSR-J1570) [AF 49(638)323] AD 426582 Unclassified

Also published in Phys. Rev., v. 128: 1634-1645, Nov. 15, 1962.

For abstract see item no. 2389, Vol. VI.

2402

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

STUDIES OF POLARON MOTION. PART III: THE HALL MOBILITY OF THE SMALL POLARON, by L. Friedman and T. Holstein. [1962] 102p. incl. diagrs. (AFOSR-J1571) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)323 and Westinghouse Electric Corp.) AD 427639 Unclassified

Also published in Ann. Phys., v. 21: 494-549, Mar. 1963.

For abstract see item no. 2390, Vol. VI.

2403

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

A NUCLEAR QUADRUPOLE RESONANCE INVESTIGATION OF THE STRUCTURE OF HEXACHLOROBENZENE, by C. B. Richardson. [1962] [1]p. incl. tables. (AFOSR-65-0178) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-196 and National Science Foundation) AD 611496 Unclassified

Also published in Acta Cryst., v. 16: 1063, Oct. 1963.

Nuclear quadrupole resonance measurements were made at -78°C of the asymmetry in the electric field gradient tensors of hexachlorobenzene single crystals. The resultant value of 0.151 ± 0.016 at each Cl nucleus supports the double bond hypothesis of asymmetry. A temperature dependence of the NQR signal between -78° and 0°C is attributed to an increase in the amplitude of the libration of each molecule about its hexad axis with increasing temperature.

2404

Politecnico di Torino. Laboratorio di Meccanica Applicata (Italy).

AN EXPERIMENTAL INVESTIGATION OF BOUNDARY LAYER WITH ADVERSE PRESSURE GRADIENT, by E. Mattioli. Dec. 1962 [24]p. incl. illus. diagrs. (Technical note no. 22) (AFOSR-4551) (AF 61(052)511) AD 404142 Unclassified

A working section was made suitable for researches on boundary layer with an adverse pressure gradient. The ceiling of the working section is formed with adjustable shutters. The 2 assembling details of the wind tunnel and of 2 additional apparatus (a probe holder gear and a micromanometer for reading directly the wind speed) are described. Preliminary researches were made in order to control the validity, at low speed, of a formula giving the resistance coefficient of the gauze screens. Experimental results to obtain a constant pressure gradient on a plate and the measurements of the intermittence factor in a cross section of the flow are reported. These measurements show the existence of an intermittence region between the turbulent boundary layer and the free-stream, undetected by the Pitot tube. The physical construction of said region and the meaning of the intermittence factor are discussed. (Contractor's abstract)

2405

Politecnico di Torino. [Laboratorio di Meccanica] Applicata (Italy).

THE SURFACE RE-EMISSION LAW IN FREE MOLECULE FLOW, by S. Nocilla. [1962] [20]p. incl. diagrs. table. (AFOSR-J1043) (AF 61(052)511) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 1: 327-346, 1963. (AFOSR-5310)

The main object of this research is a study of validity of the re-emission model already introduced by the author in the light of more recent experimental results on molecular beams. According to this model, the re-emitted molecules behave as a gas in Maxwellian equilibrium, subject to thermal agitation and moreover to a translation motion. The space distribution law is established for the molecules re-emitted from an elementary rectangular surface and from an infinite strip of elementary width. The theoretical results obtained are then compared with Hurlbut's experimental results obtained with nitrogen molecular beams inpinging on lithium fluoride crystals. The comparison enables an estimate to be made of the values of the 2 fundamental parameters (S_r and θ_r) referred to the re-emitted gas. The theoretical formulae also allow one to specify in what manner a free-molecule flow may be interpreted as a superposition of an infinite number of pencils of elementary molecular beams. (Contractor's abstract)

2406

Polytechnic Inst. of Brooklyn, N. Y.

PHASE TRANSITIONS IN SODIUM TUNGSTEN BRONZES, by A. S. Ribnick, B. Post, and E. Banks. [1932] [8]p. incl. diagrs. refs. (AFOSR-64-0774) (AF 18(600)1193) AD 436519 Unclassified

Also published in Advances in Chem., Ser. No. 39: 246-253, 1963.

The reported structures of tungsten bronzes include cubic, pseudocubic, tetragonal, orthorhombic, and monoclinic distortions of the perovskite-type structure; well-characterized tetragonal and hexagonal structures, as found in the series K_xWO_3; and some unit cells which are reported for isolated phases. This work surveys some of the phases found for various alkali tungsten bronzes. In the sodium bronzes there is a progression of distorted perovskites from $x = 0$ to $x \simeq 0.15$, in the same order as the thermal transitions of WO_3 (monoclinic → orthorhombic → tetragonal). High-temperature x-ray diffractometry shows these phases to go through the same thermal transitions as WO_3, except that 2-phase regions intervene. Between $x = 0.15$ and 0.28, 2 tetragonal phases coexist, the second having a range of homogeneity from $x = 0.28$ to 0.38. This is followed by a cubic (or pseudocubic) range from $x = 0.43$ to 0.95. (Contractor's abstract)

2407

Polytechnic Inst. of Brooklyn. [Dept. of Aeronautical Engineering and Applied Mechanics] N. Y.

THE AXISYMMETRIC SUPERSONIC FLOW NEAR THE NOSE OF A POINTED BODY OF REVOLUTION, by L. G. Napolitano and A. Ferri. [1957] [5]p. incl. diagrs. refs. (AFOSR-3572) (AF 18(600)693) Unclassified

Also published in Jour. Aeronaut. Sciences, v. 24: 900-904, Dec. 1957.

For abstract see item no. PIB. 04:016, Vol. II.

2408

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

SOME MASS TRANSFER EFFECTS ON THE WALL JET, by H. Fox and M. H. Steiger. Aug. 1962, 20p. incl. diagrs. table, refs. (PIBAL rept. no. 757) (AFOSR-3056) (AF 49(638)217) AD 284698 Unclassified

Also published in Jour. Fluid Mech., v. 15: 597-609, Apr. 1963.

The wall jet with suction or injection is investigated; an analysis under conditions corresponding to similar flows is shown to reduce to an eigenvalue problem. Asymptotic solutions valid far from the surface are used to initiate the integration and circumvent the usual iteration associated with the 2-point boundary value problem. Typical solutions for various rates of suction and injection are obtained. It is found that the skin friction decreases with increasing rate of suction. Representative thermal solutions are obtained for Prandtl and Lewis numbers equal to 1, under the special condition that the surface temperature is equal to the ambient temperature or that the enthalpy varies monotonically from the surface value to the ambient value. (Contractor's abstract)

2409

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

SOME PERTURBATION SOLUTIONS IN LAMINAR BOUNDARY LAYER THEORY. PART I. THE MOMENTUM EQUATION, by P. A Libby and H. Fox. Aug. 1962, 69p. incl. diagrs. tables, refs. (AFOSR-3711, pt. 1) (AF 49(638)217) AD 284097 Unclassified

Also published in Jour. Fluid Mech., v. 17: 433-449, Nov. 1963.

Velocity fields are considered which are associated with a variety of flows and which may be described by perturbation of the Blasius solution. These are flows which, for example, because of localized mass transfer involve the initial value problem of boundary layer theory, flows with variable ratio of viscosity-density product, and flows with mass transfer. The perturbation solutions are presented in accord with the usual linearization procedures so that further applications for the determination of first-order effects can be readily made. The results of such applications in several cases are compared to more accurate solutions.

2410

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF SUPERSONIC COMBUSTION, by A. Ferri, P. A. Libby and V. Zakkay. Sept. 1962, 118p. incl. illus. diagrs. tables, refs. (PIBAL rept. no. 713) (AFOSR-3940) (In cooperation with General Applied Science Labs., Westbury, N. Y., AF 49(638)991) (Sponsored jointly by Aeronautical Research Labs; and Air Force Office of Scientific Research under AF 49(638)217) AD 445978 Unclassified

Also published in High Temperatures in Aeronautics; Proc. Symposium held in Turin to celebrate the 50th anniversay of the Laboratorio di Aeronautica, Politicnico di Torino (Italy) (Sept. 10-12), ed. by C. Ferrari. Milano, Tamburini Editore, 1964, p. 55-118.

A theoretical and experimental investigation of mixing and supersonic combustion is presented. A review of the problem under investigation is given in Section I. Then an analysis of inviscid flow fields with a finite rate chemistry for a hydrogen-air reaction is presented in Section II. In Section III, an analysis of a turbulent mixing for flows with large density gradients with no chemical reaction is presented. The analysis is compared with the experimental results. In Section IV, the results of the experiments in supersonic combustion are presented.

2411

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

THEORETICAL STUDIES OF INVISCID HYPERSONIC FLOWS WITH CHEMICAL REACTIONS, by R. Vaglio-Laurin. [1962] [16]p. incl. diagrs. (AFOSR-64-1032) (AF 49(638)217) AD 440975 Unclassified

Also published in The High Temperature Aspects of Hypersonic Flow, Proc. of the AGARD-NATO Specialists' Meeting, Rhode-Saint-Genese (Belgium) (Apr. 3-6, 1962), ed. by W. C. Nelson. New York, Pergamon Press, 1963, 133-148.

Continuum flows about blunt-nosed slender bodies representative of missiles and satellites are considered with emphasis on observables. Solutions applicable near the nose and very far downstream are presented and evaluated by comparison with a large number of results obtained by numerical experiments. Effects of chemical reactions on fluid mechanical aspects of the problem, in particular on similitude, are discussed.

2412

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

INVESTIGATION OF PLATES AND SHELLS UNDER EXTERNAL LOADING AND ELEVATED TEMPERATURES, by J. Kempner. Final rept. Feb. 1962, 24p. incl. refs. (PIBAL rept. no. 599) (AFOSR-2280) (AF 49(638)302) AD 275308 Unclassified

An investigation was made of plates and shells under external loading and elevated temperatures. Problems of special interest to designers of missiles and aircraft are included. (Contractor's abstract)

2413

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

A NEW APPROACH TO THE NUMERICAL INTEGRATION OF DIFFERENTIAL EQUATIONS, by J. R. M. Radok. [1959] 7p. (AFOSR-3742) (AF 49(638)302) Unclassified

Presented at the Annual meeting of the Gesellschaft für Angewandte Mathematik und Mechanik, Hannover (West Germany) Mar. 23-28, 1959.

Steady states normally associated with elliptical equations are idealizations and it is more natural to study them as limiting states of transient processes described by parabolic or hyperbolic equations. One is immediately led to the employment of computers as experimental tools for the testing of mathematical models for the simulation of physical processes. In principle, the above is extremely simple and plausible, but its execution requires a great deal of preliminary work, one line of which is the main subject of this paper. In the search for more efficient methods for the solution of difference differential equations, a full utilization of the asymptotic character of the sought solutions was tried. With this object in mind, an investigation of the use of exponential functions for the purpose of extrapolation from initial or previously predicted data has been undertaken with promising results.

2414

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

REVIEW OF ELECTROMAGNETIC DRAG EFFECTS ON SPACE VEHICLES, by K. P. Chopra. [1961] [16]p. incl. refs. [PIBAL rept. no. 643] (AFOSR-447) (AF 49(638)445) Unclassified

Presented at Amer. Astronaut. Soc. Symposium on Interactions of Space Vehicles with an Ionized Atmosphere, Washington. D. C., Mar. 17, 1961.

Various electromagnetic effects contributing to the drag of a space vehicle moving in an ionized atmosphere pervaded by a magnetic field are reviewed. These effects are classified into 2 broad categories based on whether the electromagnetic phenomena are induced inside the space vehicle or in the surrounding atmosphere. The effects falling in the second category may be analyzed from points of view of the atmosphere being treated as a continuum. Such areas, where improvements can be made to gain useful information of interactions of a space vehicle in an ionized atmosphere pervaded by a magnetic field, are indicated. Of special interest is a suggested model of an ionized cloud around the space vehicle.

2415

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON THREE-DIMENSIONAL SWIRLING WAKES, by M. H. Steiger. Feb. 1962, 10p. (PIBAL rept. no. 739) (AFOSR-2216) (AF 49(638)445) Unclassified

The velocity fields of 3-dimensional viscous wakes with small swirl and streamwise pressure gradients are examined with the use of the boundary layer approximations, Oseen's linearization of the convective terms, and the asumption of constant fluid properties. Transform methods yield mathematically exact solutions with general types of initial conditions. The theory, while applicable to many practical problems (such as describing the phenomena in a tip vortex), is not applied here and its application is left for future investigation. (Contractor's abstract)

2416

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON THE ACCURACY OF APPROXIMATE THRUST STEERING SCHEDULES IN OPTIMAL CORRECTIONAL MANEUVERS, by S. E. Meckowitz. Feb. 1962 [37]p. incl. diagrs. tables. (PIBAL rept. no. 741) (AFOSR-2284) (AF 49(638)445) AD 274749 Unclassified

A frequent variational problem is one for which the fuel expenditure is to be minimized. In practice, approximate thrust steering schedules that vary bilinearly or linearly with time are introduced to reduce the multidimensional trials involved in attaining a numerical solution. The degree of approximation is established which is induced when these approximate programs are used for the correctional maneuver characterized by a small parameter which is related to the percentage change in orbital characteristics. For the maneuver the thrust magnitude is assumed to be constant and can be of the same order as the central force. It is proved that if there is an acceptable error in the minimum value of the burning time then the bilinear program is applicable regardless of imposed end constraints. However, for a special class of correctional maneuvers, defined by the property that boundary conditions are weakly dependent upon the circumferential displacement, one can utilize the simpler linear program with the same degree of accuracy. Numerical verification of this theory is given by considering examples and comparing the results of burning time and terminal values of the dependent variables with exact solutions. (Contractor s abstract)

2417

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

LAMINAR, TRANSITIONAL, AND TURBULENT HEAT TRANSFER TO A CONE-CYLINDER-FLARE BODY AT MACH 8.0, by V. Zakkay and C. J. Callahan. Feb. 1962 [56]p. incl. diagrs. tables, refs. (PIBAL rept. no. 737) (AFOSR-2359) (AF 49(638)445) AD 274122 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 1403-1413, 1420, Dec. 1962.

An experimental investigation of the laminar, transitional, and turbulent heat transfer rates over a conical cylindrical flared body is presented. Regions of favorable, zero, and adverse pressure gradient on the body are investigated. The experimental results are compared with theory. The model was tested at a free stream Mach number of 8 and a Reynolds number of 1.6×10^5 to 0.3×10^5 per in. based on free stream conditions. Various stagnation-to-wall temperature ratios were obtained by cooling the model prior to the test with liquid nitrogen. The stagnation-to-wall temperature ratios ranged from 10 to 3.3. Theoretical predictions gave good results for the heat transfer rates in the laminar region, and fair prediction in the transitional and turbulent regimes extending over the shoulder and forward portion of the cylindrical body. Over the aft portion of the cylinder and over the flare, the predictions are only qualitatively correct and underestimate the heating rate by a factor as high as 2. Conversely, the flat plate reference enthalpy method is found more closely to predict the heat rates over the aft portion of the body, but increasingly to overestimate the heating rates over the forward portion of the cylinder. A modified equation for the heat transfer coefficient in the transitional and fully turbulent region based on the FPRE (flat plate reference enthalpy) method is then presented. This method gives good agreement with the experimental results. The following is concluded from the results: Cooling the wall delayed transition By expanding the flow rapidly between the cone and the cylinder, the transition Reynolds number is reached very rapidly. By making a smooth transition between the cylinder and the flare, no separation

occurred at the cylindrical flare junction. The transitional and turbulent heat transfer in the presence of an adverse pressure gradient may be predicted with sufficient accuracy by the FPRE method. (Contractor's abstract)

2418

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

A STUDY OF AERODYNAMIC EFFECTS OF ISOTHERMAL AND TEMPERATURE GRADIENT ATMOSPHERES ON RE-ENTRY TRAJECTORIES, by L. Rute Mar. 1962, 23p. incl. illus. diagrs. refs. (PIBAL rept. no. 738) (AFOSR-2411) (AF 49(638)445) AD 281765 Unclassified

The behavior of skip and impact trajectories of space vehicles entering an atmosphere in which temperature varies with altitude is studied. The atmosphere is divided into layers, each of which is characterized by an appropriate temperature gradient. Numerical results for heat transfer rates, relative decelerations and altitude as functions of flight time, and an altitude-range history for STD Day (ARDC Model Atmosphere, 1959) Hot and Cold Day, are presented for selected re-entry conditions. These results are compared with those obtained in an isothermal (exponential) atmosphere for the same re-entry conditions. The difference in peak heat transfer rates and maximum relative decelerations in the 2 atmospheric models is not significant for properly selected scale heights. However, the effect of temperature variation upon minimum elevation for the skip trajectory and upon range to point of impact for impact trajectories is noticeable. (Contractor's abstract)

2419

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

THERMAL AND CHEMICAL EFFECTS IN WAKES, by M. H. Bloom. [1962] [14]p. incl. diagrs. refs. (PIBAL rept. no. 732) (AFOSR-2419) (AF 49(638)445) AD 611191 Unclassified

Presented at AGARD meeting on High Temperature Aspects of Hypersonic Flow, Brussels (Belgium), Apr. 3-6, 1962.

The far-wake, the regions in which diffusive phenomena become important and boundary-layer phenomena can be approximated, is discussed quantitatively. The thermal and chemical effects bearing on observable phenomena are discussed, along with the fluid mechanical factors that these effects depend upon. Topics include: scaling, similitude, and orders of magnitude; temperature distributions and electron densities in far-wakes calculated with coupled diffusion and detailed rate chemistry of multicomponent air; effects of differing values of the Lewis and Prandtl number; 3-dimensional effects; stream-wise pressure gradient effects; and unsteady effects.

2420

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

COMPRESSIBLE VISCOUS FLOW IN A TWO-DIMENSIONAL ADIABATIC CHANNEL, by J. Soong and M. H. Bloom. May 1962, 38p. incl. diagrs. tables, refs. (PIBAL rept. no. 749) (AFOSR-2968) (AF 49(638)445) AD 278128 Unclassified

The analysis of compressible viscous flow in a 2-dimensional adiabatic channel is made by means of a boundary layer approximation. In particular, 2-dimensional laminar flow within parallel adiabatic walls is treated. Some solutions were obtained which are in agreement with the results of more conventional 1-dimensional flow analysis as far as pressure gradient and choking length are concerned. However, in the well-behaved cases profile changes involving popping and reverse flow are observed. This can be explained on the basis of nonuniformity in density and momentum over the cross section. Another set of cases which exhibit more unusual behavior are obtained. They are largely associated with positive pressure gradients in subsonic flow and negative pressure gradients in supersonic flow. It is observed that, due to non-uniform velocity, the flow may be partially supersonic and partially subsonic over a section. Mathematically, the initial pressure gradient can be prescribed in this analysis. Therefore, the unusual pressure gradient cited can be obtained in principle. The physical significance of the unusual solutions is discussed.

2421

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

THREE-DIMENSIONAL EFFECTS IN VISCOUS WAKES, by M. H. Steiger and M. H. Bloom. June 1962, 32p. incl. diagrs. table. (PIBAL rept. no. 711) (AFOSR-2969) (AF 49(638)445) AD 278129 Unclassified

Presented at IAS Natl. Summer meeting, Los Angeles, Calif., June 19-22, 1962.

Also published in AIAA Jour., v. 1, 776-782, Apr. 1963.

Three-dimensionality in wake-like or jet-like free mixing is investigated. The first section of the report deals with the general mathematical model, in which the boundary layer approximations are used and with methods of solution. Laminar and turbulent flow, compressibility, unsteadiness and streamwise pressure gradients are admitted initially. The flux forms of the equations are given. Algebraic integrals of the energy equations and the diffusion (frozen-flow) equations are obtained. A simplification of the convective terms, roughly corresponding to the Oseen approximation, is used in the asymptotic downstream region. This results in linearization in the case of constant-fluid-properties, and permits the derivation of convenient solutions. Corresponding first-approximation solutions are obtained for the compressible case. Finally, second-approximation improvements are derived. The second section contains explicit solutions for specific configurations, in

particular for flows whose initial isovels are of ellipdc shape. These flows may be wake-like or jet-like. Compressibility is admitted; however, the flows must have uniform pressure and be steady. The final section deals with interpretation and evaluation of the results. (Contractor's abstract)

2422

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON THE DISTRIBUTION OF ENTROPY WITHIN THE STRUCTURE OF A NORMAL SHOCK WAVE, by M. Morduchow and P. A. Libby. Aug. 1962, 70p. incl. diagrs. refs. (PIBAL rept. no. 759) (AFOSR-3198) (AF 49(638)445 and AF 49(838)717) AD 284699 Unclassified

Presented at Symposium on Chemical Engineering in Space Technology, New Orleans, La., Mar. 10-13, 1963.

A unified mathematical account is given of the available knowledge, together with additional new results of the entropy distribution through a normal shock wave. The most notable feature of this distribution is the fact that as long as heat conductivity is present the entropy will first increase within the shock until it reaches a maximum value at a certain point inside of the shock, and then diminishes to its final value behind the shock. A physical discussion of the results is given in addition to a review of the phenomena not usually included in the analysis of shock wave structure. A systematic review of classical shock wave structure according to the Navier-Stokes equations is included here together with a discussion of the physical validity of these equations. The structure of, and the entropy distribution within weak shock waves in general, and shock waves of arbitrary strength with Prandtl numbers of 0, 3/4 and infinity are analyzed in detail, together with qualitative results for shock waves in general.

2423

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

AN APPROACH TO PROBLEM OF OPTIMUM ROCKET TRAJECTORIES, by S. E. Moskowitz and L. Ting. [1960] [3p. (AFOSR-3398) (AF 49(638)445) Unclassified

Also published in ARS Jour., v. 31: 551-553, Apr. 1961.

For abstract see item no. 2159, Vol IV.

2424

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON TAKE OFF FROM CIRCULAR ORBIT BY SMALL THRUST, by L. Ting and S. Brofman. Aug. 1962, 28p. incl. diagrs. (PIBAL rept. no. 758) (AFOSR-3900) (AF 49(638)445) AD 284799 Unclassified

Analytic solutions for the trajectories of taking off from a circular orbit by low thrust at a finite angle to the radial vector are presented. The solution is uniformly valid for the entire time interval measured from the initial instant of take-off, $t = 0$, to $t = O(1/\epsilon)$ subjected to the upper limit set by the assumption of small thrust, where ϵ is the ratio of thrust to the central force at $t = 0$. The zero order solution, which is in error to the order ϵ, is a function of the "slow" time variable $\tau = \epsilon t$ and reduces to Tsien's solution for circumferential thrust. Due to the long time interval, $t = 0$ to $O(1/\epsilon)$, the standard techniques for the next order solution break down. The present solution is obtained by splitting it into 2 parts; one is a non-oscillatory function of τ and the other is an oscillatory function of t with varying periods. With this scheme it is possible to simplify the equations by estimating the order of magnitude of the terms for the entire interval. For the first order solution the non-oscillatory part is uniquely determined from an integral equation while the oscillatory term cannot be uniquely determined. This indeterminacy is removed by the requirement of the vanishing of the secular terms in the second order solution when the same scheme of splitting the solution is applied. The same technique can be repeated to obtain higher order solutions. Comparison with several results from numerical integration of the complete equation shows how the addition of the first order solution increases the accuracy of the analytic solution.

2425

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

LINEARIZED DIFFUSION IN A RELAXING CONVECTING GAS WITH PRANDTL AND LEWIS NUMBER EFFECTS, by P. M. Sforza. Sept. 1962, 22p. incl. diagrs. (PIBAL rept. no. 725) (AFOSR-3979) (AF 49(638)445) AD 287463 Unclassified

The linearized model of an ideal gas with diffusion processes and rate reaction is applied to 1-dimensional unsteady motion generated by initial nonuniformities of state and velocity. The time-dependent system resembles that of steady, 2-dimensional, free mixing of jet or wake type. The temporal and spatial character of the profiles of flow variables is studied analytically for the conditions of state and velocity nonuniformities with various combinations of Lewis and Prandtl numbers. This model corresponds to a 2-dimensional viscous free mixing flow of an ideal dissociating gas with state variations of temperature and concentration.

2426

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

[FLUID MECHANICAL AND DYNAMICAL PROBLEMS EMANATING FROM HYPERVELOCITY FLIGHT], by A. Ferri. Final rept. Sept. 1, 1958-Oct. 31, 1962. Nov. 1962, 7p. (AFOSR-3980) (AF 49(638)445) AD 292720 Unclassified

A bibliography is presented covering the following problems: favorable interference at supersonic speeds; the shock generator technique of reducing hypersonic heat transfer; the study of the dynamics of flight of aircraft, missiles and satellite vehicles; the mechanics of collision between particles and solid surfaces to determine the details of the drag mechanism at extreme altitudes; an investigation of magnetohydrodynamic flows with application to communication with, and propulsion of, hypersonic space vehicles; and the theoretical and experimental investigation of boundary layer problems in high speed flow, with particular application to mixing and wakes.

2427

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mathematics] N. Y.

ON CALCULATION OF THE LAMINAR SEPARATION POINT, AND RESULTS FOR CERTAIN FLOWS, by M. Morduchow and S. P. Reyle. [1962] [2]p. incl. tables, refs. (AF 49(638)445) Unclassified

Published in Jour. Aerospace Sci., v. 29: 996-997, Aug. 1962.

In view of the difficulty of calculating the laminar separation point exactly, and of the slight discrepancies even among exact solutions, it appears particularly worthwhile to have available an approximate, simple, reliable method of locating the separation point in a given adverse pressure gradient. The purpose of this note is to show the application of the method given by Morduchow and Clarke to several types of flows. The method is shown to be quite simple and accurate for various flows.

2428

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

A CREEP LAW TO ACCOUNT FOR MATERIAL COMPRESSIBILITY, by F. A. Cozzarelli, B. Venkatraman and S. A. Patel. July 1962, 6p. (PIBAL rept. no. 656) (AFOSR-3005) (AF AFOSR-62-200) AD 282331 Unclassified

Based on the linear stress-strain relations of classical elasticity and the analogy between creep and nonlinear elasticity, a creep law governing the behavior of compressible materials is formulated. The strain and complementary energy functions associated with the analogous elastic law are developed. Finally the nonlinear elastic law is used in deriving the moment-curvature relations governing the lateral bending of thin plates.

2429

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

CREEP ANALYSIS OF COMPRESSIBLE CIRCULAR PLATES, by S. A. Patel, F. A. Cozzarelli and B. Venkatraman. Aug. 1962 [15]p. incl. diagrs. tables. (PIBAL rept. no. 657) (AFOSR-3893) (AF AFOSR-62-200) AD 287042 Unclassified

A creep bending analysis of compressible circular plates is presented. The analysis is based on an iterative procedure applicable in general to such plates subjected to radially symmetric lateral loads. Solutions for moments and deflections are obtained for simply supported and clamped edge circular plates under uniformly distributed loads. (Contractor's abstract)

2430

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

BIOT'S VARIATIONAL PRINCIPLE IN HEAT CONDUCTION, by T. J. Lardner. [1962] [11]p. incl. diagrs. tables, refs. (AFOSR-J437) (AF AFOSR-62-200) Unclassified

Also published in AIAA Jour., v. 1: 196-206, Jan. 1963.

Biot's variational principle is applied to a number of different 1-dimensional heat conduction problems. These problems show the applicability of the variational principle to problems involving prescribed heat flux boundary conditions and to those with temperature-dependent material properties. A method is introduced for including boundary conditions when these are expressed as prescribed heat fluxes. The idea behind this is overall energy balance within the body, which is a constraint condition to be satisfied by the time histories of the generalized coordinates. The variational principle is then applied to the well-known problem of constant surface heat flux in order to present the technique and provide a basis for the remaining sections. The equivalence of the result obtained in applying the variational principle for a prescribed surface temperature history to that obtained for a prescribed heat flux is also pointed out. Radiation cooling due to fourth power radiation from semi-infinite solids and finite slabs together with radiation according to Newton's law of cooling is then treated. Finally, the introduction of temperature-dependent material properties is discussed and the determination of the temperature distribution in a semi-infinite solid with variable properties is investigated. (Contractor's abstract)

2431

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

RADIATION BY A UNIFORMLY ROTATING POINT CHARGE, by H. Abele. June 1962, 28p. (PIBAL rept. no. 753) (AFOSR-4091) (AF AFOSR-63-11) AD 290780 Unclassified

The spectral distribution of the radiation emitted by a uniformly rotating point charge in a dielectric medium is evaluated and compared to the Cerenkov radiation of a uniformly moving charge. Two particular cases of dispersive medium are analyzed. First the orbit of the

charge is assumed to be enclosed in a perfectly conducting cylinder which acts as a mirror for the radiation; in the second case the charge rotates around a dielectric rod; and an analysis is conducted of the excitation of waves which propagate along the rod. (Contractor's abstract)

2432

Polytechnic Inst. of Brooklyn. [Dept. of Chemical Engineering] N. Y.

NOVEL TECHNIQUE FOR CHARACTERIZATION OF ADSORPTION RATES ON HETEROGENEOUS SURFACES, by L. M. Naphtali and L. M. Polinski. [1962] [7]p. incl. diagrs. (AFOSR-J605) (AF 49(638)337) AD 414005 Unclassified

Also published in Jour. Phys. Chem., v. 67: 369-375, Feb. 1963.

A novel technique is proposed for obtaining and interpreting data on adsorption rates to a catalyst surface. The method is illustrated by actual data from a hydrogen-on-nickel system. The amount of adsorbed gas on a catalyst which is part of an isothermal system varies with time when the pressure changes. The variation depends on the adsorption kinetics and the heterogeneity of the surface. For a sinusoidally varying pressure, the dependence of the adsorption amplitude and phase lag on the frequency is one way of characterizing adsorption kinetics. The "frequency response" to an induced sinusoidal pressure variation of the moles of gas adsorbed on a uniform surface having first-order kinetics can be computed theoretically. A heterogeneous surface is assumed to be an assembly or series of "different uniform-surfaces" randomly interspersed. An assembly of such surfaces, characterized by different rate constants, has an out-of-phase component of the adsorption which resembles a spectrogram, separating the effect of different types of surface sites irrespective of the fact that adsorptions are occurring simultaneously on unlike sites. As an illustration of the technique, hydrogen adsorption was studied on a supported nickel catalyst. The effect of oxygen addition to the catalyst on the adsorption kinetics of hydrogen was studied. It was found that an increase in oxygen content reduced the amount of fast adsorption and increased the slow adsorption. It was possible to characterize and separate the rates of adsorption of both the fast and the slow types. (Contractor's abstract)

2433

Polytechnic Inst. of Brooklyn. [Dept. of Chemistry] N. Y.

PHOTOCHEMICAL REACTIONS IN PLASTICS, by G. Oster. Final rept. Feb. 28, 1959-Sept. 30, 1962, Dec. 1962 [29]p. incl. diagrs. refs. (AFOSR-4376) (AF 49(638)293) Unclassified

This report contains reprints of 4 articles written under this contract: Photoreduction of Dyes in Rigid media, I & II (item no. PIB.14:001, Vol. II and item no. 1701, Vol. III); Interdependence of Excited States of Dichroic Molecules (item no. 2434, Vol. VI); and Modifications of Spectral and Semiconducting Properties of Polyvinyl dene Chloride by Ultraviolet Light of Specific Wavelengths (item no. 2325, Vol. V)

2434

Polytechnic Inst. of Brooklyn. [Dept. of Chemistry] N. Y.

INTERDEPENDENCE OF EXCITED STATES OF DICHROIC MOLECULES, by G. Oster and G. K. Oster. [1962] [10]p. incl. diagrs. refs. (AF 49(638)293) Unclassified

Published in Luminescence of Organic and Inorganic Materials; Internat'l. Conf., New York U., N. Y. [1961] ed by H. P. Kallmann and G. M. Spruch. New York, Wiley & Sons, 1962, p. 186-195.

Triphenylmethane dyes which lack trigonal symmetry of their substituent groups are colored green in solution. Apparently the 2 absorption bands at each end of the visible spectrum are associated with the 2 dichroic axes. Although the free dye is photochemically inactive, the dyes when bound to high polymers in solution are capable of being photoreduced. Furthermore, the bound dye is fluorescent while the free dye is not, due to competing internal conversion processes which are suppressed on binding. Excitation with near ultraviolet light gives a green fluorescence (positively polarized) while excitation with red light gives a deep red fluorescence (negatively polarized). Hence it appears that the 2 absorption bands are independent electronic systems. Excitation with blue light, on the other hand, gives green fluorescence plus a little red fluorescence. Flash spectroscopy of bound dye was carried out using extremely high intensity filtered light. Excitation with red light caused a reversible decrease of the long wavelength absorption band while excitation with blue light resulted in a reversible decrease in both peaks. The production of metastable species is not appreciably influenced by the presence of oxygen. Furthermore no self-quenching of these species is observed. It is concluded that the excited molecule imbedded in the polymer is protected from external quenching influences. (Contractor's abstract)

2435

Polytechnic Inst. of Brooklyn. [Dept. of Chemistry] N. Y.

PEROXIDE DECOMPOSITION AND CAGE EFFECT, by W. Braun, L. Rajbenbach, and F. R. Eirich. [1962] [5]p. incl. tables. (AF 49(638)331) Unclassified

Published in Jour. Phys. Chem., v. 66: 1591-1595, Sept. 1962.

After assuming that the lifetime of the acetoxy radical is of the same order as the "lifetime" of a "germinate diffusive combination" reaction (cage) and assuming that ethane results from the germinate combination of methyl radicals, it is possible to relate the amount of ethane formed to microscopic diffusion parameters and the lifetime of the acetoxy radical, while assuming "free" diffusion of the radical pairs. The calculation

lead to results consistent with these assumptions. The rate constant for the decarboxylation of the acetoxy radical was calculated to be $k = 1.6 \times 10^9$ sec^{-1}, at 60°, and the activation energy, 6.8 kcal/mol. In order to evaluate the possibility of the reaction scheme involving the germinate combination of a methyl radical with an acetoxy radical to explain the "cage" methyl acetate experimentally observed, a calculation was carried out assuming this mechanism. The ratio of cage methyl acetate to cage ethane was thus calculated and it agreed remarkably well with the experimentally observed rate. (Contractor's abstract)

2436

Polytechnic Inst. of Brooklyn. [Dept. of Chemistry] N. Y.

PHOTOCHEMICAL STUDIES IN FLASH PHOTOLYSIS. II. PHOTOLYSIS OF ACETONE WITH FILTERED LIGHT, by N. Slagg and R. A. Marcus. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-240) (AF 49(638)-772) Unclassified

Also published in Jour. Chem. Phys., v. 34: 1013-1017, Mar. 1961.

Flash photolysis was studied in the absence of wavelengths below 200 mμ. Effects of acetone pressure, light intensity, added biacetyl, temperature, and wavelength were investigated. The results are consistent with primary acts postulated previously on the basis of low-intensity studies, but with the absence of complicating first-order secondary reactions at these high radical concentrations. Deactivation of excited molecules explains the pressure effect on the C_2H_6/CO ratio, for wall effects are absent under flash conditions. A hot radical mechanism is suggested by the data for methane formation. The effect of wavelength on C_2H_6/CO ratio in regions centered near 260, 280, and 295 mμ is rather striking, and the results are compared with trends in low-intensity studies in the same pressure region. (Contractor's abstract)

2437

Polytechnic Inst. of Brooklyn. [Dept. of Chemistry] N. Y.

PHOTOCHEMICAL STUDIES IN FLASH PHOTOLYSIS. IV. INTENSITY AND WAVELENGTH EFFECTS, by A. Shilman and R. A. Marcus. [1962] [7]p. incl. diagr. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)772 and Alfred P. Sloan Foundation) Unclassified

Also published in Bull. Soc. Chim. Belg., v. 71: 653-659, Nov.-Dec. 1962.

Wavelength and intensity effects which have been observed in the flash photolysis of acetone are reviewed. Marked nonmonotonic wavelength effects occurred in the different regions investigated (260, 280, and 300 mμ) and serve to emphasize the problem of interpreting any data obtained with unfiltered light. The data at 300 mμ were compared with those obtained with continuous light sources 10^6 fold less intense. A considerable difference occurred in the C_2H_6/CO ratio. To investigate this intensity effect, flash photolysis was made over a wide range of reduced intensities, as low as 10^4 fold less than the maximum one, and the transition intensity region for a change in C_2H_6/CO ratio and CO quantum yield was located. This phenomenon illustrates the more general fact that the apparent primary processes observed at typical flash intensities need not be the same as the primary processes found at low intensities. (Contractor's abstract)

2438

Polytechnic Inst. of Brooklyn. [Dept. of Chemistry] N. Y.

PHOTOLYSIS OF DIBORANE AT 1849 A, by W. C. Kreye and R. A. Marcus. [1961] [9]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)772] and Office of Naval Research) Unclassified

Published in Jour. Chem. Phys., v. 37: 419-427, July 15, 1962.

The photolysis of diborane at 1849 A has been studied. The products have been found to be H_2, B_4H_{10}, B_5H_{11}, and, at low pressures, a —BH— polymer. Reaction orders at 4°C have been obtained from linear plots of reaction products vs time for a range of diborane pressures from 0.08 to 80 cm, and at 2 light intensities. Linear relations between products and time existed only at very low conversions (~1%) which required the development of a low-temperature separation method for manipulating and analyzing the traces of B_4H_{10} and B_5H_{11}. Because of the reactivity of these compounds, a detailed conditioning procedure was employed for the glass system. A mechanism consistent with the kinetic data and sugged by the kinetic results of thermal and photosensitized decomposition of diborane is postulated: the B_5H_{11} is assumed to be formed from a dissociation of B_2H_6 into BH_3's, the latter arising from an excited molecule. The B_4H_{10} and polymer are assumed to be formed from a dissociation of B_2H_6 into B_2H_5 and H, followed by radical recombination. There is a significant difference between the kinetics of thermal and photochemical B_5H_{11} formation, a result which may be due to the considerable energy excess of the 1849 quantum over that needed for dissociation (~125-kcal excess). The primary quantum yield of the step forming B_2H_5 and H is about 10 times higher than that of the one forming BH_3's. A rather rough estimate suggests that the former is of the order of magnitude of unity. (Contractor's abstract)

2439

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

COMBUSTION INSTABILITY: NON-LINEAR ANALYSIS OF WAVE PROPAGATION IN A LIQUID PROPELLANT

ROCKET MOTOR, by S. Z. Burstein and V. D. Agosta. Mar. 1962, 134p. incl. diagrs. refs. (Rept. no. PRL-62-15) (AFOSR-2614) (AF 49(638)165) AD 282970 Unclassified

A simplified model for the combustion of a bipropellant spray, with droplet break up, in the steady and nonsteady state, in a liquid propellant rocket motor, is presented. Only the longitudinal modes of nonlinear high frequency combustion instability are considered, and the method of obtaining a priori prediction of the stability or shocking limits of these pressure waves in a given rocket configuration is shown. In addition, a new technique for obtaining the composition of a complex chemical system in equilibrium is used. The longitudinal modes of nonlinear high frequency combustion instability in liquid propellant rocket motors are studied theoretically by maintaining the nonlinearity of the differential equations.

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Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

COMBUSTION INSTABILITY; SHOCK WAVE PROPAGATION IN A LIQUID PROPELLANT ROCKET MOTOR, by W. Chinitz and V. D. Agosta. June 1962. 94p. incl. diagrs. tables, refs. (Rept no. PRL-62-13) (AFOSR-3498) (AF 49(638)165) AD 282969 Unclassified

A model is presented for longitudinal shock wave propagation in liquid propellant rocket engines. The equations are written for the gas subsystem with appropriate terms included in the conservation equations to account for the evaporation and subsequent combustion of liquid fuel drops. Drag terms are included to account for the friction which may exist between the gas and liquid fuel drops when the velocities of each subsystem are not equal. The possibility of droplet shattering due to the action of large aerodynamic forces is also included in the analysis. Finally, the effect of gaseous dissociation is included employing the assumption that chemical equilibrium exists in the gas at the stations of interest. This analysis indicates that mass and heat addition and drag effects will substantially affect the gas dynamic state downstream of a shock wave. Qualitatively, the addition of mass appears to be the predominating effect. The analysis is employed to examine the effects of shock waves on a system in which liquid drops are suspended in an oxidizing atmosphere. The analysis is also utilized to examine shock wave propagation in a liquid propellant rocket engine.

2441

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

NONLINEAR FLEXURAL VIBRATIONS OF SANDWICH PLATES, by Y.-Y. Yu. Feb. 1962. 19p. incl. refs. (Technical note no. 12) (AFOSR-1310) (AF 49(638)453) AD 289871 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 34: 1176-1183, Sept. 1962.

A set of nonlinear equations describing the vibrations of sandwich plates is derived. These equations are then applied to a plate vibrating in plane strain and to a rectangular plate, with the boundary edges assumed to be hinged in both cases. It is shown that the nonlinear frequencies increase with the amplitude of vibration and that transverse shear deformations play an important role. However, the effect produced by these deformations decreases with increasing amplitudes of vibration. (Contractor's abstract, modified)

2442

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

APPLICATION OF VIBRATIONAL EQUATION OF MOTION TO THE NONLINEAR VIBRATION ANALYSIS OF HOMOGENEOUS AND LAYERED PLATES AND SHELLS, by Y.-Y. Yu. [1962] [8]p. incl. refs. (AFOSR-2256) (AF 49(638)453) AD 289868 Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Eng., New York, Nov. 25-30, 1962.

Also published in Jour. Appl. Mech., v. 30: 79-86, Mar. 1963.

An integrated procedure is presented for applying the variational equation of motion to the approximate analysis of nonlinear vibrations of homogeneous and layered plates and shells involving large deflections. The procedure consists of a sequence of variational approximations. The first of these involves an approximation in the thickness direction and yields a system of equations of motion and boundary conditions for the plate or shell. Subsequent variational approximations with respect to the remaining space coordinates and time, wherever needed, lead to a solution to the nonlinear vibration problem. The procedure is illustrated by a study of the nonlinear free vibrations of homogeneous and sandwich cylindrical shells, and it appears to be applicable to still many other nomogeneous and composite elastic systems. (Contractor's abstract)

2443

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

VIBRATIONS OF SANDWICH PLATES AND SHELLS, by Y.-Y. Yu. Final rept. Nov. 1962, 6p. (AFOSR-4162) (AF 49(638)453) Unclassified

The objective of the research was to investigate the various aspects of vibrations of plates and shells, and, in particular, those of sandwich and layered plates and shells. Some related equilibrium problems were also studied; both theory and application were emphasized.

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Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

NONLINEAR VIBRATION ANALYSIS OF PLATES AND SHELLS (Abstract), by Y.-Y. Yu. [1962] [2]p. (AFOSR-64-2472) (AF 49(638)453) AD 453960 Unclassified

Also published in Nonlinear Problems; Proc. of a Symposium, Wisconsin U., Madison (Apr. 30-May 2, 1962) ed. by R. E. Langer. Madison, Wisconsin U. Press, 1963, p. 284-285

An approximate method is presented for the analysis of nonlinear vibrations of plates and shells involving large deflections. The proposed method consists of a sequence of variational approximations based upon the variational equation of motion. The first of these involves an approximation in the thickness direction and yields an approximate system of differential equations of motion and appropriate boundary conditions for the plate or shell. When some or all of these differential equations and/or boundary conditions cannot be solved and satisfied exactly, subsequent variational approximations with respect to the remaining space coordinates and time may be further carried out. The derivation of the plate and shell equations and the steps taken in the solution therefore constitute a continuous process. The method is applicable in layered composite plates and shells as well as those of the homogeneous type. For illustration of the method, the nonlinear free vibrations of sandwich plates and cylindrical shells are studied. The vibration study included the effect of transverse shear deformation, the importance of which has been established previously on linear vibrations of sandwich structures. For nonlinear vibrations on such structures, the importance of the transverse shear effect on the frequency is found to decrease with increasing vibration amplitude. It is also shown that both the transverse shear and nonlinear effects are of less importance to cylindrical shells than to plates. (Contractor's abstract, modified)

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE DERIVATION OF NETWORK FUNCTIONS FROM PHASE FUNCTIONS, by S. Deutsch. Mar. 6, 1962 [22]p. incl. diagrs. refs. (Research rept. no. PIBMRI-1006-62) (AFOSR-2406) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)-1505) AD 277511 Unclassified

Equations are developed for deriving a network function F(s) given its phase function T(θ). Several numerical examples are given. In each case, the recurrence of the given T(θ) function in F(jθ) is a means of checking the accuracy of the derived F(s) function. The real part of log F(jθ) yields the log magnitude response, log M(θ). The examples indicate that the mathematical operations of findings F(s) are relatively simple. The equations are also employed to evaluate certain definite logarithmic integrals.

2446

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

BILINEAR PATTERN CLASSIFIERS, by J. F. Kampmeier. Mar. 12, 1962, 26p. incl. diagrs. table, refs. (Research rept. no. PIBMRI-996-62) (AFOSR-2417) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF 18(600)1505) AD 277417 Unclassified

An analysis of the requirements for a portion of a general pattern recognition system, and the design of a classifier which meets those requirements are presented. The problem of pattern recognition is divided into 2 parts, measurement and classification. Classification alone is considered in this report. It is shown that the function of a classifier can be reduced to the realization of an arbitrary, n-variable switching function. A further requirement upon the classifier is that it must be capable of learning through experience. Several methods of designing a classifier with learning ability are found either to be unreasonably complex or to not have sufficient flexibility in realizing switching functions. A new type of net work is introduced which meets the requirements for a practical classifier. The classifier netowrk becomes capable of learning if feedback is added. Application of Laplace transform theory shows that correct recognition of patterns occur after several presentations of all patterns to be classified. (Contractor's abstract)

2447

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

CARRIER MULTIPLICATION IN Ge AT X-BAND, by S. J. Freedman. Feb. 27, 1962 [28]p. incl. illus. diagrs. refs. (Research rept. no. PIBMRI-995-62) (AFOSR-2652) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF 18(600)1505) AD 288994 Unclassified

Experiments have been performed to observe breakdown in Sb-doped Ge at 4.2°K under strong rf illumination at 9.3 kmc/sec. An interpretation of the results in terms of a phenomenological rate equation shows that the relaxation times for carrier multiplication are too long to allow efficient harmonic generation. The switching times measured for breakdown are used to explain previous results of Seeger on a proposed low temperature limiter. Preliminary measurements of the third harmonic field induced at 78°K seem to confirm the field depence of a recent theory of Paranjape. (Contractor's abstract)

2448

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE THEORY AND DESIGN OF F M. RECEIVERS, by D. Hess. May 11, 1962, 84p. incl. diagrs. (Research

rept. no. PIBMRI-1026-62) (AFOSR-2654) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF 18(600)1505) AD 282110
Unclassified

The spectrum of an FM wave modulated by gaussian noise is studied. As the rms frequency deviation of the wave becomes greater than the maximum frequency component of the modulating signal, the power spectrum of the FM wave becomes gaussian in form independent of the power spectrum of the modulating signal. The response of linear band-pass networks to an FM signal is studied. The response of the linear network is written as the sum of a quasi static response and an error term. The quasi static response is a modified version of the steady state response. The modification permits a very tight bound to be put on the error term and hence leads to very tight bandwidth specifications on FM filters. Several new and several existing FM demodulators are studied to establish design criteria for the demodulators. Finally the ability of a phase-lock loop to demodulate an FM signal is studied. Relationships are derived which specify the minimum closed loop bandwidth needed to demodulate a given FM signal with a specified amount of output distortion. The design of a phase-lock demodulator is considered with and without the use of a limiter. It is shown that an increase in closed loop bandwidth takes the place of limiting. (Contractor's abstract, modified)

2449

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A HOMOGENEOUS NETWORK APPROACH TO SELF-STRUCTURING SYSTEMS, by R. J. Feldmann. June 1962, 84p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-1014-62) (AFOSR-2657) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF 18(600)1505) AD 282031 Unclassified

A homogeneous network approach to self-structuring systems is reported. The homogeneous delay networks provide a suitable physical realization of a system in which self-structuring could occur. The investigation of the general network aspects of self-structuring systems is an attempt to formulate the inherent physical and structural limitations of any structured system. Only the network aspects of self-structuring systems are investigated. Future activity should be directed toward the application of the homogeneous delay networks to the investigation of the nature of self-organization.

2450

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

CONSTANT EFFICIENCY 2N-PORT NETWORKS, by H. Kurss. May 7, 1962 [4]p. (Rept. no. 1027) (AFOSR-2751) (AF 18(600)1505) Unclassified

The efficiency of a 2N-port network is the fraction of the input power which is delivered to the load. It is shown that a 2N-port whose input is zero for all lossless loads will have a constant efficiency for arbitrary active or passive loads. The general constant efficiency 2N-port is represented as the cascade connection of a lossless 2N-port with either a ratio repeater or a power reverser or both. These component networks have constant efficiencies which, are, respectively, +1, an arbitrary positive number, -1. For reciprocal networks the ratio repeater is absent while for passive networks the power reverser is absent.

2451

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE OPTIMAL CONTROL OF CHEMICAL PROCESSES, by C. B. Brosilow. July 3, 1962 [114]p. incl. diagrs. refs. (Research rept. no. PIBMRI-1023-62) (AFOSR-2398) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF 18(600)1505) AD 286160
Unclassified

Attention is focused on obtaining a near optimal controller, for chemical processes, which is simple to design and inexpensive to implement. Pontryagin's technique is used to show that for a quadratic objective function, and a process which is described by a set of ordinary differential equations, linear in the controllable variables, the optimal control is on-off control, when the controllable variables are assumed to be bounded. A technique of parameter optimization is developed and used to obtain the equations which specify the switching times. These equations are restricted to processes which can be approximated by stable, linear, stationary differential equations. For the special case of one switch it is shown that the control law can be transformed into a switching criterion which is linear in the process outputs. Employing this criterion continuously results in a feedback controller which requires only a relay and a summing device for implementation. Analog computer studies on the control of both underdamped and overdamped systems with the 'one switch into the future' optimal controller show that this controller gives a virtually dead beat type of response even for severe disturbances. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

CRITICALLY-DAMPED COMPENSATION FOR BROADBAND AMPLIFIERS, by S. Deutsch. July 23, 1962 [25]p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-1051-62) (AFOSR-4503) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF 18(600)1505) AD 293853 Unclassified

Also published in I. E. E. E. Trans. on Circuit Theory, v. CT-10: 141-145, Mar. 1963.

Lossless critically-damped 2-terminal and 3-terminal ladders are considered as a means of compensating for parasitic shunt capacitance in broadband amplifiers. Equations are presented that simplify the design of these ladders. The capacitance and inductance values are tabulated for ladders that contain up to 7 reactive elements. The analysis is extended to the limiting cases of an infinite number of elements. The element values and transient responses of these optimum ladders are derived. Using a figure of merit that is based on the slope of the step response at its half-amplitude point, the infinite 2-terminal ladder is 59% better than an uncompensated circuit while the 3-terminal ladder is 117% better. (Contractor's abstract)

2453

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

FREQUENCY OF MODULATION NOISE, by J. T. Frankle. Aug. 31, 1962, 63p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-1041-62) (AFOSR-4504) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF 18(600)1505) AD 608942 Unclassified

The noise characteristics of a commercial FM receiver were determined experimentally and compared with the theoretical results of Middleton and Stumpers. The theoretical solutions are derived on the basis of both gaussian and rectangular receiver IF characteristics. The experimental results follow the rectangular solution for low carrier to noise ratio and the gaussian solution for high carrier to noise ratio. This is explained by the characteristics of the receiver and FM noise theory. A novel technique, employing an envelope detector, is used to measure carrier to noise ratio prior to the FM detector. The thesis also includes information helpful in consolidating the FM noise theory in the literature.

2454

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

DC EFFECTS UNDER MICROWAVE EXCITATION OF THIN FERRITE FILMS, by W. Heinz. Oct. 3, 1962, 58p. incl. diagrs. (Research rept. no. PIBMRI-1086-62) (AFOSR-4603) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF 18(600)1505) AD 298304 Unclassified

The dc voltage, developed along the plane of a thin film of ferromagnetic or ferrimagnetic material under microwave excitation, has been observed in ferrite. The voltage is generated along the direction of the microwave magnetic field, which is perpendicular to the static field (also in the film plane). An expression is derived for the voltage developed across a film located in a standing wave pattern near a point of maximum magnetic field. It is a modification of a formula developed by Juretschke for metals, to include ferrites. Two magnetite (Fe_3O_4) films were investigated at X-band. In order to build up the fields sufficiently for the signal to be detected, the films were mounted in a cavity. The cavity was critically coupled at ferromagnetic resonance and the incident peak power was varied between one and three kilowatts. The linear relation between voltage and incident power, and the reversal of voltage with dc magnetic field reversal were confirmed experimentally. The experimental curve shape of the voltage vs static magnetic field was intermediate between a dispersion type and an absorption-type. The voltage developed in ferrites is considerably lower than that in ferromagnetic conductors because the effect depends on the microwave current density in the film. Thus, we have a sensitive means for the detection of ferromagnetic resonance in thin films of good conductors, but this application is not practical for ferrite films. In the case of the latter, the phenomenon may shed light on the conductivity, Hall effect, and magnetoresistance at microwave frequencies.

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Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

ANALYSIS OF THREE COUPLED OSCILLATORS, by H. S. Hou. July 25, 1962 [24]p. (Research rept. no. PIBMRI-946-61) (AF 18(600)1505) Unclassified

The special simple problem of 3 coupled oscillators is analyzed from a number of points of view to shed light on the nature of various general approximation procedures which may be employed. These approximation procedures are, essentially of the "coupled mode" form.

2456

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

CHEMICAL ANALYSIS OF IRON CONTENT OF FERRITES, by V. L. Garik and L. M. Silber. Jan. 16, 1962 [5]p. (Rept. no. 986) (AF 18(600)1505) Unclassified

A method for the analysis of ferrous and ferric ion in ferrites and related compounds is described. Step-by-step procedures are given for sample preparation, standardization of reagents, and titration. (Contractor's abstract)

2457

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

CONVERGENCE PROPERTIES OF A MODEL-REFERENCE ADAPTIVE CONTROL SYSTEM FROM A SIMPLE STABILITY CRITERION, by J. J. Bongiorno, Jr. [1962] [8]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(600)1505] and Army Research Office (Durham)) Unclassified

Published in Proc. Nat'l. Electronics Conf., v. 18: 250-259, Oct. 1962.

A technique is presented which, in conjunction with a Nyquist-like stability criterion, permits the establishment of the convergence properties of a class of linear time-varying systems. The results are applied to a model-reference adaptive control system. An important asset of the technique presented is that it allows stability and convergence properties to be established from the peak value of the real-frequency amplitude response of a time-invariant linear transfer characteristic. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

MICROWAVE PROPERTIES OF THIN FERRITE FILMS, by L. M. Silber. Feb. 27, 1962 [8]p. (Research rept. no. PIBMRI-997-62) (AF 18(600)1505) Unclassified

The magnetic properties of thin ferrite films have been investigated both by conventional microwave methods, and by observation of the dc Hall effect voltage which is associated with ferromagnetic resonance. These measurements allow determination of the saturation magnetization, resonance linewidth or relaxation time, gyromagnetic ratio, extraordinary Hall coefficient, and magneotresistance anisotropy. While the Hall effect measurement can be made on films too thin to measure by conventional microwave techniques, the Hall voltage is proportional to the microwave current density, and thus is largest in films of high conductivity. It has been possible thus far to study ferromagnetic resonance by the dc signal only in magnetite, while films of magnetite and nickel, magnesium, manganese, copper ferrites, mixed ferrites, and ferrialuminates have been studied by conventional microwave methods. The measurements reveal that the best films have magnetization, gyromagnetic ratios, and linewidths which are quite comparable to those of the corresponding bulk ferrites. Films which are not prepared properly show deviations from bulk properties such as reduction of saturation magnetization and greatly increased linewidth. Possible explanations, such as strain and exchange anisotropy, will be discussed. Apart from their use in conventional microwave devices, the films also give promise of allowing the determination of ferromagnetic exchange constants through observation of spin wave resonance.

2459

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

A MOLECULAR BEAM HIGH POWER METER, by W. K. Kahn. July 23, 1962 [5]p. (Rept. no. 1055) (AF 18-(600)1505) Unclassified

Also published in Proc. I. E. E. E., v. 51: 1251-1252, Sept. 1963. (AFOSR-J1400; AD 431076)

It is proposed to utilize the second order Stark effect on a beam of molecules, e.g., ammonia gas molecules, to measure the RF electric field of a high power electromagnetic wave. Several alternative sensor schemes are proposed. The device should be useful for powers in the neighborhood of 1 M watt at X-band.

2460

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

NARROW-BAND TV USES PSEUDO-RANDOM SCAN, by S. Deutsch. [1962] [3]p. incl. illus. diagrs. [AF 18-(600)1505] Unclassified

Published in Electronics, v. 35: 49-51, Apr. 1962.

An ingenious very narrow bandwidth (10 kc/s only) television system is proposed, relying on the statistical rarity of fast motion and the fact that the eye, while sensitive to flicker, is more tolerant to gradual fade. The proposed system has a resolution of ~45,000 picture elements which is of the same order as that of an indifferently adjusted inexpensive receiver. The principle consists of a random dot scan, so that despite the very long frame period of 2.667 sec every region of the screen is covered by the scanning dot several times during that period. The scanning process proceeds in 3 steps: (1) A coarse vertical scan at 768 c/s is moved horizontally at 24 c/s to give 32 lines/field; (2) This 768 c/s rate is derived from the master generator at 18,432 c/s, which waveform is superimposed to give a stepped dot pattern, the beam remaining stationary for ~0.25 μsec; (3) Finally, square waves are added to this dot pattern to produce the small-area pseudo-random sampling, the entire dot array being slightly shifted every 1/24 sec, the process repeating after the full local scan of the small area containing 64 picture elements has been completed. Hence the frame period of 64/24 = 2.667 sec. All 3 scan processes are produced with 6 square waves only, all derived by division from the 18,432 c/s source. They are explained by means of block diagrams and waveform diagrams including those of synchronizing and shaping circuits. A brief description of the transmitter and receiver is given.

2461

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

APPLICATION OF PONTRYAGIN'S MAXIMUM PRINCIPLE: LINEAR CONTROL SYSTEMS, by G. L. Collina and P. Dorato. June 1962, 33p. incl. diagrs. refs. (Research rept. no. PIBMRI-1015-62) (AFOSR-2655) (AF 18(603)105) AD 287333 Unclassified

The problem of linear, continuous-time, deterministic optimal, control systems is discussed. In particular it is shown, via Pontryagin's maximum principle, that linear optimal control systems always result from the combination of (1) a linear plant; (2) integral quadratic performance criterion; and (3) no constraints on the plant input. The controller synthesis is outlined in the general time-varying case and various illustrative examples are included. A comparison of the maximum principle approach with dynamic programming and the classical calculus of variations, is also included. Both

driven and undriven control systems are considered. For the case where the time-interval of optimality is infinite, the stability of the optimal system is investigated. It is shown that stability is assured whenever the integral of the performance criterion is positive definite. (Contractor's abstract)

2462

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE ANALYSIS AND SYNTHESIS OF RC SYNCHRONOUS NETWORKS, by B. M. Tobin. June 5, 1962 [174]p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-1016-62) (AFOSR-2770) (AF 18(603)105) AD 290782 Unclassified

A major problem in the field of ac control systems is the synthesis of suitable electrical compensating networks which operate on the envelopes of modulated signals. Classical time-variant compensating networks suffer from a number of disadvantages. RC synchronous networks in which the basic reactive elements are synchronously-switched capacitances whose current polarities reverse periodically at twice the carrier frequency overcome these drawbacks. Although successful single capacitance synchronous networks have been constructed an exact theory upon which a logical synthesis procedure can be based has been lacking. A unified theory of analysis and synthesis of RC synchronous networks is presented. The theory leading to a rigorous procedure for synthesizing an RC synchronous network which realizes a prescribed envelope voltage transfer function is developed.

2463

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PLANT-ADAPTIVE OPTIMAL SYSTEMS, by P. Dorato. Mar. 9, 1962 [4]p. incl. diagrs. (PIBMRI-1005-62) (AF 18(603)105) Unclassified

The purpose of this note is to indicate how the relationship between controller and plant parameters may be obtained. It is interesting to note that often in the synthesis of optimal control systems one obtains part of the solution to the adaptive problem. Consider, for example, a plant with dynamics, in state space, of the form $\dot{x} = f(x, u, w)$, where x represents the plant output, u the control input, and w a constant plant-parameter vector. The value of the parameters in the controller depend, of course, on the plant-parameter vector w. If a relationship between the parameters of the controller and w can be established, then a adaptive path may be included in the optimal system to maintain optimality.

2464

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

FEEDBACK DESIGN AND OPTIMAL CONTROL THEORY, by J. G. Truxal and P. Dorato. Oct. 22, 1962, 8p. incl. refs. (Research rept. no. PIBMRI-1095-62) (AFOSR-4079) (AF AFOSR-62-280) Unclassified

Also published in WPAFB Conf. on Optimum System Synthesis, Dayton, Ohio, Sept. 11-13, 1962.

The optimization techniques of Pontryagin (maximum principle) and Bellman (dynamic programming) are evaluated as feedback design tools. The first part of the paper is devoted to a discussion of the advantages of optimal closed-loop (feedback) operation. The second part of the paper is devoted to an analysis of the feedback nature of the 2 optimization techniques cited and an analysis of the current computational difficulties in applying these techniques. (Contractor's abstract)

2465

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON THE DESIGN OF LINEAR PROCESS ADAPTIVE CONTROL SYSTEMS, by H. N. Yagoda. Aug. 31, 1962, 102p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-1075-62) (AFOSR-4510) [AF AFOSR-62-280] AD 295074 Unclassified

The problem is presented of controlling a stable, slowly time varying, linear process. A solution is proposed that is simple, practical and applicable to any finite order process. Use is made of a continuously adjusted tandem compensator; a comparison of the weighted histories of the input and output signals is used to control this adjustment. System design is based upon the use of a variable transfer function characterization for both the compensator and the process. In effect, a compensator is designed that attempts to cancel the variable poles of the process with variable zeros, the variable zeros of the process with variable poles and the variable process gain with its reciprocal. The design technique developed is applied to several problems. The processes involved range from a variable gain amplifier through a plant that contains a variable gain and 2 pair of variable complex poles. The processes are grouped in accordance with the number of variable parameters in the process characterizing function.

2466

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE RESPONSE OF AN AUTOMATIC PHASE CONTROL SYSTEM TO FM SIGNALS AND NOISE, by D. L. Schilling. June 1962, 136p. incl. diagrs. tables. (Research rept. no. PIBMRI-1040-62) (AFOSR-4502) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF AFOSR-62-295) Unclassified

Also published in Proc. IEEE, v. 51: 1306-1316, Oct. 1963.

An automatic phase control system is analyzed to determine its response to frequency modulated signals and narrowband Gaussian noise. Emphasis is placed on the system's response to frequency ramp modulated signals. In contradistinction to previous analyses, the assumptions of a linearized system and of a S/N ratio greater than unity were not made. The response of the system to an FM signal is obtained using a perturbation technique and perturbing about the solution to the nonlinear pendulum problem. A piecewise-linear solution is also presented and used to extend the class of solutions obtainable when using the perturbation technique. The piecewise-linear technique does not result in as good an approximation, but it can be used when the system is critically-damped, or over-damped.

2467

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON THE MINIMAL SET OF COMPATIBLES FOR CLOSURE, by W. C. W. Mow. Oct. 1962, 36p. incl. tables. (Research rept. no. PIBMRI-1084-62) (AFOSR-4505) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF AFOSR-62-295) AD 295633 Unclassified

Given an incompletely specified sequential switching function in the form of flow table, Paull and Unger had provided a systematic procedure for reducing the function into a set of maximum compatibles. A technique is presented here for selecting a minimal closed set of compatibles without the process of enumeration. The rules have been applied to numerous examples including those presented by Paull and Unger.

2468

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SYMMETRIES OF UNIFORM WAVEGUIDE CONTAINING ANISOTROPIC MATERIALS, by Y. Knoishi. Aug. 20, 1962 [26]p. incl. diagrs. table. (Research rept. no. PIBMRI-1052-62) (AFOSR-4506) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF AFOSR-62-295) AD 293852 Unclassified

Waveguides, which have symmetry, have simpler electrical characteristics and equivalent circuits and the symmetry sometimes serves as better matching characteristics than general waveguides when the waveguide includes anisotropic material. The anisotropic conditions under which waveguides can keep the symmetries are discussed. As a practical example, it is also shown what kind of dc magnetic field may be applied to Ferrite materials so that the symmetry of the waveguide is preserved. (Contractor's abstract)

2469

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

MEASUREMENT OF NEURON ACTIVITY BY PARAMAGNETIC RESONANCE, by M. A. Kelly. Nov. 9, 1962, 18p. incl. diagrs. (Research rept. no. PIBMRI-1071-62) (AFOSR-4508) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF AFOSR-62-295) AD 291441 Unclassified

This report proposes a theory for measuring neuron activity at any desired location in a living animal by a technique that requires no physical contact between the subject and the detector. The theory postulates that free radicals are produced in the formation of neuron action potentials, and that the concentration of these free radicals can be measured by magnetic resonance techniques. A device to test these postulates has been built, but does not yet possess the sensitivity needed to give the theory a meaningful test. The design and construction of this device is described. (Contractor's abstract)

2470

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

FILTERS WITH POLES HAVING EQUAL VERTICAL SPACING, by R. I. Disman and S. Deutsch. Sept. 24, 1962 [22]p. incl. diagrs. table. (Research rept. no. PIBMRI-1077-62) (AFOSR-4509) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF AFOSR-62-295) AD 291550 Unclassified

In the Butterworth criterion for maximally flat low-pass amplitude response the poles are spaced by equal angles on a unit circle in the left hand s-plane. This configuration does indeed give a good cut-off in filters but at the expense of the transient response. The poor transient response is due to the poles which approach the j-axis; their specific contributions are described mathematically. The above problem was considered when a filter was needed to give a band-limited output to an input of sampling pulses. It was decided to place the poles on the unit circle, with equal vertical spacing, so as to try to compromise between good cut-off and acceptable transient response. From the pole distribution the following calculations were performed: amplitude response, time delay, impulses response, and step response. A synthesis was also performed to determine the corresponding circuit configuration. The above calculations were performed for 2, 3, 4, and 5 reactive element circuits. A Butterworth filter of 5 reactive elements is compared to a corresponding filter with equal vertically-spaced poles with respect to amplitude response, time delay, and transient response. (Contractor's abstract)

2471

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROBABILITY DISTRIBUTION AT THE OUTPUT OF A LOGARITHMIC RECEIVER, by S. Geldston. Oct. 4, 1962, 102p. incl. diagrs. refs. (Research rept. no. PIBMRI-1087-62) (AFOSR-4719) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under AF AFOSR-62-295) AD 298294 Unclassified

A statistical study of the behavior of the logarithmic receiver in an environment of bandlimited white noise and signal plus noise is presented. The output probability densities, the means, variances, and higher moments are calculated for various input noise and signal levels. A significant feature of the logarithmic receiver is that the magnitude of the output variance about its mean value is independent of the magnitude of the input noise level, provided that the dynamic range is not exceeded. Thus, the combination of logarithmic receiver and high pass filter can be used as a technique for obtaining a constant false alarm rate for systems operating in a noisy environment. The degradation of sensitivity for the logarithmic receiver is proportional to the logarithm of the number of pulses integrated. The sum and difference output distribution from the twin channel logarithmic configuration to an input of bandlimited white noise is calculated. The importance of the twin channel configuration is stressed because of its application to tracking radars that use the monopulse technique and to height finders that use the multibeam technique. A comparison is made of the output power spectral density between the logarithmic receiver and the linear receiver, both having an input of bandlimited white noise. The procedure consists of calculating the autocorrelation function at the output of the logarithmic receiver. By means of the Fourier transform of the autocorrelation function, the power spectral density is thus determined. When comparison is made with a linear receiver, a considerable amount of spectral power at the output of a logarithmic receiver is found to be centered about even harmonics of the IF frequency.

2472

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

OPTIMIZATION OF MULTIVARIABLE SAMPLED DATA CONTROL SYSTEMS, by J. Lieutaud. Sept. 1962, 50p. (Research rept. no. PIBMRI-1078-62) (AFOSR-4720) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office, and Office of Naval Research under AF AFOSR-62-295) AD 297251 Unclassified

This study is concerned with the optimization of multivariable sampled-data control systems. A squared error performance criterion is chosen and the effects of controllability and observability are studied. In particular it is shown that the optimization can always be carried out on a system all of whose coordinates are both controllable and observable. In each case several illustrative samples are included. (Contractor's abstract)

2473

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

COHERENT DETECTION ON PULSED RADARS, by A. Kerdock. June 1962, 33p. incl. diagrs. (Research rept. no. PIBMRI-1103-62) (AF AFOSR-62-295) AD 295076 Unclassified

Coherent detection on a pulsed radar is discussed from a statistical decision theory viewpoint. The Neyman Pearson test is applied to 2 cases; first, where it is desired to detect targets moving with one particular radial velocity, and second, where it is desired to detect targets at all velocities equally well. In the first case it is shown that, in a sense an ideal integrator is achieved; i.e., the results are exactly the same as if all the power reflected from the target were received in one pulse, rather than many. A mechanization for the second case is given. The statistics for a suboptimum integrator which approximates the Neyman Pearson test in a simpler form are derived. The performance of this integrator is compared with that for the ideal noncoherent integrator. (Contractor's abstract)

2474

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROCEEDINGS OF THE SYMPOSIUM ON MATHEMATICAL THEORY OF AUTOMATA, New York, Apr. 24-26, 1962, ed. by J. Fox, M. Crowell, and R. Meyerson. Brooklyn, Polytechnic Press, 1963, 640p. incl. diagrs. tables, refs. (Microwave Research Inst. Symposia Series, v. 12) (In cooperation with Inst. of Radio Engineers and American Inst. of Electrical Engineers) (Sponsored jointly by Air Force Office of Scientific Research, Army Research Office (Durham), and Office of Naval Research under [AF AFOSR-62-295]) Unclassified

The book contains a detailed presentation of 32 lectures delivered at the above symposium, organized by the Brooklyn Polytechnic Institute with the support of a number of military-scientific organizations and the IEEE. Apart from 3 general lectures, given by distinguished guests in the opening session, the distribution of the lectures by subject is as follows: computability—5 lectures; classes of automata and construction of proofs—6 lectures; algebraic theory of automata—8 lectures; theory of nets and switching—6 lectures; theory of search and adaptive processes—3 lectures. The collection ends with a brief account of a panel discussion on the connection of the theory of calculating machines with the concept of computability. The main conclusions are that a knowledge of the theory of computability saves programmers from such blind alleys as, for example, the attempt to construct a universal debugger; the Turing

machine continues to be the basic model for workable calculating machines; such generalizations of calculating processes as the introduction of chance, the unification of man and machine in a single system, and likewise the use of infinitely much information as initial data, do not extend the classical notion of computability. (Math. Rev. abstract in part)

2475

Polytech Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

TRANSMISSION OF F. M. SIGNALS THROUGH LINEAR FILTERS, by D. [T.] Hess. [1962] [8]p. incl. diagr. [AF AFOSR-62-295] Unclassified

Published in Proc. Nat'l. Electronics Conf., v. 18: 469-476, Oct. 1962.

The response of a linear filter to an FM signal is derived. The response is expressed as a closed form function of the instantaneous frequency of the input wave plus an error term on which a tight bound is kept. The bound is appreciably tighter than other existing bounds. With the linear filter response as a basis, an inequality is derived which relates the bandwidth of a linear filter to the amount of phase distortion appearing in the output FM signal. With this inequality, an example is computed which shows that the bandwidth required to transmit a commercial FM signal with less than 1% phase distortion is 225 kc—the experimentally determined bandwidth required to transmit a commercial FM signal.

2476

Pomona Coll. [Dept. of Physics] Claremont, Calif.

MICROANALYSIS WITH ULTRASOFT X-RADIATIONS, by B. L. Henke. Jan. 1962, 37p. incl. illus. diagrs. refs. (Technical rept. no. 6) (AFOSR-1995) (AF 49-(638)394) AD 272771 Unclassified

Presented at Tenth annual Conf. on Application of X-ray Analysis, Denver, Colo., Aug. 7-9, 1961.

Also published in Advances in X-Ray Anal., v. 5: 285-305. 1962.

The diffraction, reflection, absorption, fluorescence and the electronic emission which results from the interaction with ultrasoft x-rays are presented as practical bases for microanalysis. Recent developments on sources and detectors for the ultrasoft x-radiations are described. A preliminary report of a current investigation on low energy photo-Auger electron analysis and on a new type of low energy electron spectrometer is also presented. (Contractor's abstract)

2477

Pomona Coll. Dept. of Physics, Claremont, Calif.

PHYSICS AND APPLICATION OF X-RAY AND ELECTRONS IN THE 100 TO 1000 EV REGION, by B. L. Henke. Interim final rept. May 1962 [7]p. incl. diagr. (AFOSR-4532) (AF 49(638)394) Unclassified

The first phase of this program was to systematically work through the interactions of the ultrasoft x-ray region, obtaining interaction coefficients, developing efficient generators, detectors, and spectrometers for these studies, and initiating the development of applications to the 3 primary areas of interest: the analysis of microscopic systems, thermal-nuclear reactions, and understanding the creation and characteristics of the earth's ionosphere.

2478

Pomona Coll. Dept. of Physics, Claremont, Calif.

MICRORADIOGRAPHY, by B. L. Henke. [1960] [7]p. incl. illus. diagrs. [AF 49(638)394] Unclassified

Published in Encyclopedia of Science and Technology, McGraw-Hill, 1960, p. 366-370.

In microradiography, it is convenient to be able to generate a wide range of essentially monochromatic beams by exciting secondary fluorescent radiation from a variety of elements with a single high intensity source of primary rays, such as the Machlett AEG-50 tungsten target tube. The technique of contact microradiography consists of (1) preparation of a sample in the form of a small piece generally unmounted with a thickness of .1mm or less for metals and other dense materials considerably greater if necessary for biological specimens; (2) placement of the sample in close contact with a fine-grained photographic film in a simple camera or light tight envelope; (3) exposure to a suitable x-ray beam; (4) enlargement of the developed image, which appears as a black spot. Thus the photographic image itself takes the place of the usual specimen for microscopic observation. Graininess may begin to interfere at magnifications of 300, although satisfactory results are often obtained up to 800. A number of special microradiographic techniques applicable to life science and industrial testing which have been developed are described.

2479

Pomona Coll. [Dept. of Physics] Claremont, Calif.

A NEW COMMERCIAL X-RAY PROJECTION MICROSCOPE, by O. S. Poen. [1960] [8]p. incl. illus. diagrs. [AF 49(638)394] Unclassified

Presented at Ninth annual Conf. on Application of X-Ray Analysis, Denver, Colo., Aug. 10-12, 1960.

Published in Advances in X-Ray Anal., v. 4: 301-308, 1961.

A recently developed Dutch commercial projection x-ray microscope is described. The principal features are: simplified focusing by using reflected electrons, 4 different target materials exchangeable during operation, and binocular viewing of either the specimen itself or the fluorescent image. The specimen and film chamber is evacuated and the voltage is variable between 5 and 20 kv. Some results are shown. (Contractor's abstract)

2480

Pomona Coll. [Dept. of Physics] Claremont, Calif.

PROJECTION MICROSCOPY AND MICROANALYSES, by O. S. Peen. [1961] [11]p. incl. illus. diagrs. [AF 49(638)394] Unclassified

Presented at Tenth annual Conf. on Application of X-Ray Analysis, Denver, Colo., Aug. 7-9, 1961.

Published in Advances in X-Ray Anal., v. 5: 324-334, 1962.

Results of recent experiments on microanalyses with an x-ray projection microscope will be reviewed. As the use of monochromatic radiation is imperative, spectral analyses of the point source were carried out. A simple stationary divergent-beam-type transmission spectrograph was used. The shape and size were miniaturized to fit in the specimen holder of the Norelco projection unit. Emission spectra from clean targets and the fluorescent radiation emerging from a 10- to 50-μ-diam spot of contaminated targets and of 2-layer targets are shown. The spectra were recorded photographically. In addition, a proportional counter, in combination with the R. C. L. 128-channel pulse-height analyzer, was used for measuring the ratio of "white" to line radiation. (Contractor's abstract)

2481

Pomona Coll. Dept. of Physics, Claremont, Calif.

PRODUCTION, DETECTION, AND APPLICATION OF ULTRASOFT X-RAYS, by B. L. Henke. [1962] [16]p. incl. illus. diagrs. refs. [AF 49(638)394] Unclassified

Published in X-ray Optics and X-ray Microanalysis; Third Internat'l. Symposium, Stanford U., Calif. (Aug. 1962), ed. by H. H. Pattee, V. E. Cosslett, and A. Engström. New York, Academic Press, 1963, p. 157-172.

The ultrasoft x-radiations are often very efficient for use in microanalysis because of 2 important and unique characteristics. First, these are ideal radiations with which to place energy into microscopic systems because the effective interaction thicknesses are typically in the micron range and smaller. Second, the interaction is relatively simple. Photoelectric absorption is the dominant primary interaction. The reduction of the resulting low-energy photoionized atomic states is dominantly by the ejection of Auger electrons. The characteristic, re-emitted energy either as Auger electrons or as fluorescent x-ray photons results in spectra which are simpler in both structure and number of lines as compared to that from conventional x-ray or optical spectra. As an example of the use of 500-v, monochromatic x radiation in contact-microradiographic analysis, the mass of single human red blood cells has been measured, with a precision of 2 or 3%. It has been demonstrated that it is possible to detect, with high electron counting rates, the presence of small percentages of all elements within the first 100A or less of the sample surfaces. In addition ultrasoft x-ray physics has become of importance in the study of radiations emanating from the sun as measured from rockets and satellites. Such applications of ultrasoft x-ray physics have in common the need for efficient sources and detectors. With the hope that such information will be of some value to workers in this relatively new field, a brief description is given of the x-ray generation and detection methods which have been employed in this laboratory for many of the applications as described.

2482

Pomona Coll. [Dept. of Physics] Claremont, Calif.

RECENT WORK IN THE 10- TO 100-A X-RAY REGION (Abstract), by B. L. Henke. [1962] [1]p. (AF 49(638)-394) Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 238, Mar. 26, 1962

An efficient high-intensity source of ultrasoft x-radiations has been developed. Relative photon-counting efficiencies for GM and proportional counters and for various photocathode surfaces mounted upon electron multiplier tubes have been investigated. A sensitive method of spectroscopic measurement has been developed based upon an energy analysis of the photo- and Auger-electron spectra excited by the ultrasoft x-ray beam. An inverse-square electrostatic spectrometer has been specially designed for this work in the 10- to 1000-ev region.

2483

Pomona Coll. [Dept. of Physics] Claremont, Calif.

SODIUM AND MAGNESIUM FLUORESCENCE ANALYSIS-PART I: METHOD, by B. L. Henke. [1962] [16]p. incl. illus. diagrs. tables. (AFOSR-3889) (AF AFOSR-62-415) Unclassified

Presented at Eleventh annual Conf. on Application of X-Ray Analysis, Denver, Colo., Aug. 8-10, 1962.

Also published in Advances in X-Ray Anal., v. 6: 361-376, 1963.

As is well known, the fluorescent yield decreases very rapidly with the atomic number with the result, for example, that sensitive sodium and magnesium analysis is extremely difficult if not impossible with conventional

x-ray spectrographs. It is demonstrated, however, that analysis for sodium and magnesium can be accomplished with sensitivity comparable to that conventionally obtained for elements such as aluminum, silicon, and phosphorous, providing that the conditions for excitation and measurement of the associated soft x-radiations are optimized. A high-intensity demountable tube using an aluminum anode has been developed which can be used interchangeably with the conventional spectrographic x-ray source. This provides a large amount of incident radiation, aluminum foil filtered, optimally close in wavelength to that of the line radiation being excited. A gypsum analyzing crystal is used along with greatly reduced beam collimation. The standard flow proportional counter and pulse height discrimination is employed. An appropriate filter, such as aluminum foil, is used as a window for the counter to provide further discrimination and enhanced signal-to-background ratio. (Contractor's abstract)

2484

Pontifical Catholic U. of Rio de Janeiro (Brazil).

POLARIZATION OF THE ELECTRET, by B. Gross and R. J. De Moraes. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-3464) (AF AFOSR-60-6) Unclassified

Also published in Jour. Chem. Phys., v. 37: 710-713, Aug. 15, 1962.

The internal charge distribution of the carnauba wax electret has been determined by a sectioning method. After polarization and cooling samples are cut into sections of different thickness. These are reheated and the ensuing discharge currents are measured. The total released charge, as determined by numerical integration of the corresponding current-time curve, gives the polarization of each section. A macroscopic space charge polarization would give charge values which, with decreasing thickness of sections, go to zero; a uniform volume polarization would give values which are independent of thickness. Measurements gave constant values and therefore prove the existence of a uniform volume polarization of the electret. (Contractor's abstract)

2485

Pontifical Catholic U. of Rio de Janeiro (Brazil).

[ELECTRETS], by B. Gross. Final rept. [1962] [8]p. incl. tables. (AFOSR-3465) (AF AFOSR-60-6) Unclassified

The main objective of this research was the investigation of the nature of the heterocharge of the electret and the determination of the space charge distribution of the system. The preparation of samples has been perfected and several series of systematic measurements have been undertaken. The results confirmed beyond doubt that the electret possesses a uniform volume polarization. In addition to space charge measurements by the dissectioning method, irradiation effects have been explored, in the expectation that they might shed light on the nature of the polarization of the electret.

2486

Pontifical Catholic U. of Rio de Janeiro (Brazil).

CHARGE STORAGE AND IRRADIATION EFFECTS IN SOLID DIELECTRICS, by P. V. Murphy. Final rept. July 1961-June 1962, 3p. (AFOSR-3178) (AF AFOSR-61-140) AD 427948 Unclassified

The results of research performed are described in a series of papers which have been submitted for publication. The title of each paper and an abstract of its content are presented in this report.

2487

Pontifical Catholic U. of Rio de Janeiro (Brazil).

THE FORMATION AND DISCHARGE OF CARNAUBA WAX ELECTRETS IN NUCLEAR RADIATION FIELDS, by P. V. Murphy. [1962] [2]p. incl. diagrs. (AFOSR-3467) (AF AFOSR-61-140) AD 428415 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 329-330, Feb. 1963.

It is reported that a 4 Mrad dose of Co^{60} γ-rays reduced the heterocharge of a thermoelectret by a factor of 8 and the density of unpaired electrons by a factor of 18. Radio-electrets were formed by the simultaneous action of an electric field and β-rays from Sr^{90}. The isothermal decay currents for radio-electrets and thermoelectrets varied with time according to $i = kt^{-n}$. The residual volume polarizations were determined and compared. That of the radioelectret was proportional to the total radiation dose.

2488

Pontifical Catholic U. of Rio de Janeiro (Brazil).

POLARIZATION OF DIELECTRICS BY NUCLEAR RADIATION. I. RELEASE OF SPACE CHARGE IN ELECTRON IRRADIATED DIELECTRICS, by P. V. Murphy and S. C. Ribeiro. [1962] [3]p. incl. diagrs. (AFOSR-J1139) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-140 and Brazilian National Nuclear Energy Commission) AD 423133 Unclassified

Also published in Jour. Appl. Phys., v. 34: 2061-2063, July 1963.

Irradiation of solid dielectrics with high-energy electrons produces a region of negative space charge which may persist for a long time. The capacity of various dielectrics for charge storage and the characteristics of thermal and photoelectric charge release are discussed. Charge storage capacity is highest in electret forming materials and in materials with a high density of deep "traps". (Contractor's abstract)

2489

Princeton U. [Dept. of Aeronautical Engineering] N. J.

AN EXPERIMENTAL STUDY OF THE DECAY OF TURBULENT ENERGY IN SEVERAL GASES AND AT HIGH AND LOW DENSITY, by W. H. Webb. Jan. 1962, 71p. incl. diagrs. tables, refs. (Rept. no. 59) (AFOSR-2302) (AF 49(638)465) AD 276521 Unclassified

A hot-wire anemometer study of the decay of turbulent energy downstream of a grid in atmospheric pressure air, argon and helium and at several ambient pressure levels in air was carried out. A variable density low speed blow-down tunnel was employed which was operated over the range 0.2 to 8 atm pressure. It was found in the decay measurements that above a grid Reynolds number, RM, of about 2,000 and at atmospheric pressure and above, an identical initial period decay law occurred independent of the gas employed or the ambient pressure level. There was no evidence indicating the invalidity of the continuum view of turbulence for this range. For RM below 1,000 or at low ambient pressure, however, a decrease in the normal turbulence intensity was found, the magnitude of which appeared to depend on the pressure level and the gas employed. (Contractor's abstract)

2490

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HOT-WIRE HEAT LOSS AND FLUCTUATION SENSITIVITY FOR INCOMPRESSIBLE FLOW, by W. H. Webb. Jan 1962, 61p. incl. diagrs. tables, refs. (Rept. no. 596) (AFOSR-2303) (AF 49(638)465) AD 276520 Unclassified

An experimental study of the forced convection, heat loss from long thin cylinders placed normal to an incompressible flow was carried out. Tests were made in 3 different gases (air, argon, helium) at atmospheric pressure and in air over a pressure range of 0.2 to 8 atm. Particular attention was given to determining the effect of cylinder temperature on the heat loss. It was found that the constants employed in the usual empirical representation of this heat loss vary with cylinder temperature in a way dependent on Knudsen number, results in helium giving a marked indication of this. A velocity fluctuation sensitivity equation was derived which includes the effects of this temperature variation. (Contractor's abstract)

2491

Princeton U. [Dept. of Aeronautical Engineering] N. J.

THE CONTINUUM THEORY OF SPHERICAL ELECTROSTATIC PROBES, by C. H. Su and S. H. Lam Apr. 1962, 46p. incl. diagrs. (Rept. no. 605) (AFOSR-3067) (AF 49(638)465) AD 283914 Unclassified

A continuum theory for negatively charged spherical electrostatic probes in a slightly ionized plasma is developed. The density of the plasma is taken to be sufficiently high such that both ions and electrons suffer numerous collisions before being collected by the probe. The probe surface is assumed to be absorbing. The ion and electron temperatures may have different values but are uniform in space. By confining attention to highly negative probe potentials, the Boltzmann distribution for electron number density is shown to be the correct approximation. Under the assumption that the probe radius, rp, is large compared with the electronic Debye distance, h_e, and that the probe potential is sufficiently negative, the structures of the potential, electron, and ion density distributions are discussed. Under such circumstances the boundary condition for ion density at the probe is unimportant. Analytical behavior of the solutions are given and a simple closed-form ion-current-voltage characteristic is obtained. Two kinds of current-voltage characteristics are constructed. One of them is specially appropriate for the determination of the ionization density. Finally, the disturbance in the plasma is found to be confined mainly to a layer adjacent to the probe. It is shown that the thickness of the layer is not or order or Debye length, whenever $P_p >> h_e$. (Contractor's abstract)

2492

Princeton U. Dept. of Aeronautical Engineering, N. J.

POINT HEAT SOURCES AND THE TEMPERATURE-VORTICITY ANALOGY IN COMPRESSIBLE BOUNDARY LAYERS, by W. J. McCroskey. May 1962 [56]p. incl. illus. diagrs. tables, refs. (Rept. no. 613) (AFOSR-3068) (AF 49(638)465) AD 284000 Unclassified

Under certain generally accepted assumptions, the analogy between temperature and vorticity for viscous, 2-dimensional, constant property flows can be extended to compressible boundary layer flows. Within the scope of the assumptions, temperature and shearing stress are linearly related, and this relation is formally valid for both laminar and turbulent flows. This paper describes a simple problem for which the temperature-shearing stress analogy is valid. The problem concerns the flow over a semi-infinite insulated flat plate with a point heat source of strength located at the leading edge. Detailed theoreticaly velocity and temperature profiles are presented for the laminar case. They are nonsimilar, and depend on the parameter. Further, the velocity and temperature profiles resemble those of a compressible boundary layer on an insulated flat plate with no heat source. An experimental program was conducted to verify the theoretical predictions.

2493

Princeton U. Dept. of Aeronautical Engineering, N. J.

SOME RESULTS FOR PLANE POISEUILLE FLOW OF RAREFIED GASES, by Y. P. Pao. Aug. 1962, 13p. (Rept. no. 619) (AFOSR-3976) (AF 49(638)465) AD 290695 Unclassified

Reasonably close upper and lower bounds are obtained for the number flux on the walls of a long 2-dimensional channel under free molecular conditions. These results are used to infer the existence of the minimum in the flow rate. (Contractor's abstract)

2494

Princeton U. Dept. of Aeronautical Engineering, N. J.

TURBULENT DECAY IN AIR, ARGON AND HELIUM, by W. H. Webb. Preliminary rept. Aug. 1961 [21]p. incl. illus. diagrs. (AFOSR-3977) (AF 49(638)465) Unclassified

It is generally accepted that turbulence is a continuum phenomenon and that under ordinary circumstances, the Navier-Stokes differential equations provide an adequate mathematical framework for the description of a turbulent field. Occasionally, however, objections are raised, based on the observation that the violent fluctuations inherent in turbulence render higher order velocity derivatives nonexistent. Appreciable molecular effects would not be expected unless some special mechanism connecting the molecular and microscopic scales is operative. One such mechanism has been proposed which predicates the local growth of molecular "clusters" as a simple mechanical result of the collisions of finite-sized molecules. It was believed that by measuring the decay of turbulence in gases of different molecular structure a crucial test of the existence of observable effects of a particular molecular mechanism would be given. The present preliminary report gives the results obtained on the decay of grid turbulence produced in 3 gases; air, argon and helium.

2495

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HEAT TRANSFER IN A RAREFIED GAS BETWEEN PARALLEL PLATES AT LARGE TEMPERATURE RATIOS, by D. R. Willis. [1962] [40]p. incl. diagrs. refs. (AFOSR-3978) (AF 49(638)465) AD 606414 Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 1: 209-225, 1963. (AFOSR-5310)

Using a relaxation type model to describe the intermolecular collisions the problem is reduced to the solution of 2 coupled nonlinear integral equations for the density and temperature of the gas. An analytic solution of these equations is obtained for the limiting case of very high plate temperature ratio. Numerical results are obtained for several temperature ratios, the lowest being 4 to 1, and for a state of rarefaction varying from free molecular to the transition regime. The numerical results are compared with results of a moment method, using 4 moments, and a first iterate method. The results of this moment method are found to be insufficiently sensitive to variations in the plate temperature ratio. The numerical results for a temperature ratio of 4 to 1 correlate reasonably well with results of a linearized 8 moment method through use of a modified rarefaction parameter. (Contractor's abstract)

2496

Princeton U. Dept. of Aeronautical Engineering, N. J.

BOUNDARY LAYER FLOW WITH SUSPENDED PARTICLES, by H. H. Chiu. Aug. 1962 [32]p. incl. diagrs. tables. (Rept. no. 620) (AFOSR-4540) (AF 49(638)465) AD 424280; AD 604821 Unclassified

The laminar boundary layer flow with particles injected upstream of the leading edge of a plate is investigated. The boundary layer equations for the gas, and the equations governing the rate of momentum and heat transfer between the gas and the particles were solved simultaneously. A series solution is constructed in terms of a system of universal functions from which the solution for the arbitrary velocity and temperature ratio of the gas and the particles at the leading edge may be calculated. A closed form solution is obtained for the particle motion. It is found, within the validity of the approximation, that the wall shear force may be larger or smaller than that of the flow of clean gas, depending on the relative magnitude of the velocity of the particles and the gas at the leading edge; and that the wall heat transfer depends primarily on the relative magnitude of the temperature of the particles and the gas at the leading edge, and upon the wall temperature.

2497

Princeton U. Dept. of Aeronautical Engineering, N. J.

EXPERIMENTAL INVESTIGATION OF BOUNDARY LAYER TRANSITION ON A FLAT PLATE WITH A POINT HEAT SOURCE AT THE LEADING EDGE, by W. J. McCroskey. Aug. 1962 [26]p. incl. illus. diagrs. refs. (Rept. no. 627) (AFOSR-4541) (AF 49(638)465) AD 604822 Unclassified

The addition of heat to the boundary layer of an insulated flat plate by means of a point heat source at the leading edge has been found to delay the transition of laminar flow to turbulence. This paper describes an experimental investigation of the variation of transition Reynolds number on a roughened flat plate model with a heat source of strength, Q, spanning the leading edge. The present problem is compared with the problem of an aerodynamically heated boundary layer on an insulated flat plate. Transition Reynolds number was found to increase with increasing S over a range equivalent to a Mach number variation of $0 < M_\infty < 0.6$. (Contractor's abstract)

2498

Princeton U. Dept. of Aeronautical Engineering, N. J.

RESEARCH ON HIGH SPEED GAS DYNAMICS, by S. M. Bogdonoff. Final rept. Sept. 15, 1958-Sept. 15, 1962, 11p. (AFOSR-4542) (AF 49(638)465) Unclassified

The original work under the subject contract was heavily concentrated on problems of boundary layers and viscous flows. The emphasis has shifted somewhat to

hypersonics, low density phenomena and magnetohydrodynamics, and a facility development to permit experimental studies in a range heretofore not available in the laboratory.

2499

Princeton U. [Dept. of Aeronautical Engineering] N. J.

LEADING EDGE OF A SHOCK-INDUCED BOUNDARY LAYER, by M. Sichel. [1962] [13]p. incl. diagrs. refs. (AFOSR-J368) (AF 49(638)465) AD 408590 Unclassified

Also published in Phys. Fluids, v. 5: 1168-1180, Oct. 1962.

The boundary layer which is formed as a shock wave propagates down a shock tube causes both shock attenuation and shock curvature. Hartunian studied the curvature effect; however, as he points out, because of the singularities at the leading edge of the boundary layer his solution is not valid where the shock wave touches the tube wall. A detailed study is now made of the flow near the leading edge of this shock-induced boundary layer for a weak shock wave. The leading flow can be divided into a shear layer near the wall, and into a free stream or shock region. By expanding Navier-Stokes equations in the small parameter M_1^*-1 and stretching the coordinates, simplified equations for the shear layer and shock region are obtained. The shear layer and shock region flows interact and it is found that the shock region must be a zone of non-Hugoniot flow where the shock structure is 2-dimensional. An approximate solution of the shock shape is obtained by replacing the shock region by an oblique shock which is approximately matched to the shear layer. (Contractor's abstract)

2500

Princeton U. [Dept. of Aeronautical Engineering] N. J.

STRUCTURE OF WEAK NON-HUGONIOT SHOCKS, by M. Sichel. [1962] [10]p. incl. diagrs. refs. (AFOSR-J1049) (AF 49(638)465) AD 418301 Unclassified

Also published in Phys. Fluids, v. 6: 653-662, May 1963.

As the curvature of shock waves increases, the shock structure becomes 2 dimensional, and the usual Hugoniot jump conditions no longer hold. An equation has been derived for the structure of such a 2-dimensional non-Hugoniot shock in the case of weak shocks with Mach numbers close to one. It appears that the non-Hugoniot region behaves as an acoustic wave driven by higher-order viscous effects. The properties of the viscous-transonic or V-T equation have been investigated. The V-T equation appears to be a combination of Burgers' equation for weak normal shock structure and the transonic equation. It is shown that the structure of oblique shocks is a similarity solution of the V-T equation. Proper formulation of boundary conditions is considered and a uniqueness proof is given for a particular restricted boundary value problem.

2501

Princeton U. [Dept. of Aeronautical Engineering] N. J.

ASYMPTOTIC THEORY OF SPHERICAL ELECTROSTATIC PROBES IN A SLIGHTLY IONIZED, COLLISION-DOMINATED GAS, by L. M. Cohen. [1962] [8]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)465 and Atomic Energy Commission) Unclassified

Published in Phys. Fluids, v. 6: 1492-1499, Oct. 1963.

The problem of an electrostatic probe in a dense, slightly ionized gas is treated by techniques of asymptotic analysis. In particular, the asymptotic limits $\rho_p = r_p/\lambda_d \to \infty$ and $\epsilon = T_+/T_- \to 0$ are treated in considerable detail. (r_p, λ_d, T_-, T_+ are probe radius, Debye length, electron, and ion temperature, respectively). Sample integral curves for electrostatic potential, ion and electron density are given. Probe characteristic curves for 3 values of ϵ (finite and small) and ρ_p (large) are also given. It is noted that these characteristics do not saturate for large probe potential because the influence of the probe is felt to very great distances from the probe; the shielding due to the space-charge sheath is incomplete. (Contractor's abstract)

2502

Princeton U. [Dept. of Aeronautical Engineering] N. J.

A GRAPHITE HEATED NITROGEN WIND TUNNEL FOR CONTINUOUS OPERATION AT MACH NUMBERS UP TO 20, by R. P. Shreeve and S. M. Bogdonoff. [1962] [25]p. incl. illus. diagrs. table. (AF 49(638)465) Unclassified

Published in Advances in Hypervelocity Techniques; Proc. of the Second Symposium, Denver, Colo. (Mar. 20-21, 1962), ed. by A. M. Krill. New York, Plenum Press [1962] p. 1-25.

Various forms of heaters have been used to preheat the test gas and thus prevent condensation from occurring in the nozzles of wind tunnels at Mach numbers greater than 5. By using heaters, conventional wind tunnel techniques have been used at Mach numbers up to about 12 in air. For higher Mach numbers, there exists a serious problem of obtaining nonoxidizing heater materials to obtain stagnation temperatures exceeding 2,800°R while operating at high stagnation pressures. The oxidation problem was avoided by using nitorgen as the test gas (since it is diatomic and very similar to air) with graphite as the heater material. A simple graphite resistance heating element has been developed which has been used regularly to supply steady gas total temperatures in excess of 5,000°R at total pressures up to about 1,000 psi. With these stagnation conditions, condensation would be avoided in an expansion of the gas in the nozzle to a test section Mach number of greater than 20. The system has been designed for continuous operation and is currently limited only by the capacity of the auxiliary equipment.

2503

Princeton U. Dept. of Aeronautical Engineering, N. J.

EVALUATION OF SWIRL ATOMIZER SPRAY CHARACTERISTICS BY A LIGHT SCATTERING TECHNIQUE, by N. Cohen and M. Webb. Feb. 8, 1962 [70]p. incl. illus. diagrs. (Aeronautical Engineering Lab. rept. no. 597) (AFOSR-2525) (AF 49(638)938) AD 274968 Unclassified

The Sauter mean diameter of the droplets produced by a swirl-type atomizer was measured over a wide range of injector pressure drop, ambient gas density, and ambient gas viscosity. The measurements were employing the optical (light scattering) technique developed at Princeton by Dobbins (item no. PRL 04:003, Vol. II). Repeatability of results was established within the experimental error, which was found to be reasonable despite the numerous but small systematic errors associated with the measurements. It was established that the light scattering technique could be conveniently applied to droplet measurements.

2504

Princeton U. Dept. of Aeronautical Engineering, N. J.

RESEARCH ON SOLID PROPELLANT COMBUSTION INSTABILITY, by R. H. W. Waesche and J. Wenograd. Final progress rept. May 1, 1961-Apr. 30, 1962. Aug. 3, 1962 [10]p. incl. diagrs. (Aeronautical Engineering rept. no. 564) (AFOSR-3277) (AF 49(638)-1073) AD 284238 Unclassified

The complex interaction of an oscillating pressure field with the flame of a burning solid propellant was studied. An understanding of this interaction is a basic necessity in the elucidation of the fundamental physicochemical processes governing the acoustic instability of solid propellant rocket motors. An oscillator-driver capable of subjecting a burning solid propellant surface to suitable pressure oscillations was developed. Theoretical consideration of the connection between the burning rate response function of a solid propellant and the acoustic admittance of the surface lead to the conclusion that at low frequency the product gas is emitted isothermally rather than isentropically. This necessitates a change is the relationship between the burning rate response function and the acoustic admittance.

2505

Princeton U. Dept. of Aeronautical Engineering, N. J.

TURBULENCE EFFECTS IN CHEMICAL REACTION KINETICS MEASUREMENTS, by I. Glassman and I. J. Eberstein. [1962] [3]p. incl. diagrs. refs. (AFOSR-J1012) (AF AFOSR-62-90) AD 417862 Unclassified

Presented at Seventeenth annual meeting of the Amer. Rocket Soc., Los Angeles, Calif., Nov. 13-18, 1962.

Also published in AIAA Jour., v. 1: 1424-1426, June 1963.

Possible sources of error that may arise in chemical kinetic measurements due to turbulent fluctuations are examined. The interest in the problem stems from the use of a flow reactor for the measurement of chemical reaction rates, on the assumption that steady-state kinetics prevail in the reactor. The ways in which turbulence may effect the reaction rate are defined, and variation of the rate with respect to temperature is established.

2506

Princeton U. Dept. of Aeronautical Engineering, N. J.

REACTION KINETICS IN TURBULENT FLOWS, by I. Glassman and I. J. Eberstein. [1962] [19]p. incl. diagrs. tables, refs. (AFOSR-64-0146) (AF AFOSR-62-90) Unclassified

A phenomenological approach to the problem of evaluating reaction kinetics in turbulent flows is presented. The conditions under which steady state kinetics may be applied, temperature or concentration terms dominate, and the rate evaluated at which the mean quantity may be used with sufficient accuracy are derived. The effect of longitudinal heat transfer in turbulent flow reactors also is discussed. (Contractor's abstract)

2507

Princeton U. [Dept. of Astronomy] N. J.

RED GIANTS OF POPULATION II. II, by M. Schwarzschild and R. Härm. [1962] [8]p. incl. diagrs. tables. (AFOSR-J300) (AF 49(638)298) AD 408038 Unclassified

Also published in Astrophys. Jour., v. 136: 158-165, July 1962.

In continuation of the work described in Paper I of this series (item no. 2508, Vol. VI) a sequence of 70 core models has been constructed for a red giant of population II, covering the helium flash. This phenomenon occurs when helium-burning starts in the contracting core. Because of the high degeneracy in the core, the new energy source causes heating, not an expansion. The rise of the temperature accelerates the helium-burning, and thus a thermal runaway occurs, which terminates only when the core becomes non-degenerate. Subsequent helium-burning causes rapid expansion and cooling. At the peak of the helium flash the temperature reaches over 300 million degrees. The rate of energy liberation at this peak corresponds to about 10^{12} solar luminosities. Practically none of this energy penetrates the thermal blanket of the nondegenerate outer layers of the helium core. The evolution at the peak is so fast that the time interval between successive numerical models had to be reduced to as low as 2 sec.

2508

Princeton U. [Dept. of Astronomy] N. J.

RED GIANTS OF POPULATION II. I, by M. Schwarzschild and H. Selberg. [1962] [8]p. incl. diagrs. tables. (AFOSR-J301) (AF 49(638)298) AD 408039 Unclassified

Also published in Astrophys. Jour., v. 136. 150-157, July 1962.

The present model sequence, which stops just at the onset of helium-burning, is being published (even though it is 3 yr old and shows satisfactory agreement with that published already by Haselgrove and Hoyle) in part to give more detailed numerical data than these authors have given, and in part to form a basis for a more recent investigation (Schwarzschild and Harm 1961), in which the helium flash was followed through in detail and which is to be described more thoroughly in the second paper of this series. The aim of the present work is solely the investigation of the physical development of the inner portions of population II red giants. Accordingly, the structure of the outer convective envelope was approximated by simple formulae of low accuracy. This has the consequence that the radii of the models derived, as well as their positions in the Hertzsprung-Russell diagram, cannot be very precise. (Contractor's abstract)

2509

Princeton U. [Dept. of Chemistry] N. J.

ANALYSIS OF THE HYDROXYL RADICAL VIBRATION ROTATION SPECTRUM BETWEEN 3900A AND 11500 A, by A. M. Bass and P. Garvin. [1962] [10]p. incl. illus. tables, refs. (In cooperation with National Bureau of Standards, Washington, D. C., CSO-680-56-30) (AF 18(603)134) Unclassified

Published in Jour. Molec. Spectros., v. 9: 114-123, Aug. 1962.

The visible and near infrared spectrum of the vibration-rotation bands of the hydroxyl radical in its ground state has been analyzed. Wave numbers and identifications for the lines in 26 bands are presented. Energy level schemes for the seventh, eighth, ninth, and tenth vibrational levels are given, along with molecular constants. The results agree well with night-sky studies. Several unidentified features of the emission are reported. (Contractor's abstract)

2510

Princeton U. [Dept. of Chemistry] N. J.

OXIDATION-REDUCTION ANALYSIS OF CRYOGENICALLY STABLE PRODUCTS OF DISSOCIATED WATER VAPOR, by H. M. Gladney and D. Garvin. [1962] [3]p. incl. table. (AF 18(603)134) Unclassified

Published in Jour. Phys. Chem., v. 66: 1560-1562, Aug. 1962.

Deposits having similar characteristics are obtained by trapping at 77°K the products from discharged H_2O vapor or H_2O_2, or from the reactions of H atoms with O or O_3. The deposits are partly crystallized, recrystallized with evolution of O on warming, and forms concentrated solutions of H_2O_2 on melting. From oxidation and reduction analyses of the solid and melted materials, it was shown that a species exists which is stable only at low temperatures. This low temperature species undergoes typical chemical reactions.

2511

Princeton U. [Dept. of Chemistry] N. J.

FORMATION AND DISSOLUTION OF PLATINUM OXIDE FILM: MECHANISM AND KINETICS, by S. W. Feldberg, C. G. Enke, and C. E. Bricker. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-J896) (AF 49(638)467) Unclassified

Presented at meeting of the Electrochem. Soc., Los Angeles, Calif., May 6-10, 1962.

Also published in Jour. Electrochem. Soc., v. 110: 826-834, July 1963.

Oxide film formation on a smooth platinum electrode in perchloric acid solution has been studied as a function of potential, current, time, and electrode history, using constant current and controlled potential techniques. Anodic film formation proceeds through 2 single electron steps: a slow step followed by a fast (reversible) one. During film reduction, the fast step occurs first, followed by the slow step. In the case of constant current reduction, the slow step does not occur, and the film is exactly half-reduced. Complete reduction requires several hours at a controlled potential. Three electrode states are thus clearly defined: oxidized, half-reduced (active), and completely reduced or clean. A single kinetic equation quantitatively relates the current, potential, and time parameters, predicts the initial rate of open-circuit potential decay following film formation, and strongly suggests that the oxide is a chemisorbed film.

2512

Princ[illegible] J. Dept. of Chemistry, N. J.

ELECTROCHEMISTRY OF FILMS, by C. G. Enke. Final rept. Oct. 7, 1960-Oct. 31, 1962. 8p. incl. diagrs. (AFOSR-4876) (AF 19(638)973) AD 416507 Unclassified

The work on the silver-silver chloride system using the stabilized dc operational amplifiers started by applying a current step to a silver electrode and observing the potential change as a function of time. The formation of a silver chloride film was found to be a fast and reversible reaction. Several interesting phenomena were observed. A peak in the potential, when applying an anodic current to a clean electrode, was noted; this is thought to be caused by the nucleation of silver chloride islands on the electrode. Secondly, a very large capacitance was observed; this could be caused by either a much larger electrode area than calculated or to specific adsorption of reactant, or both. Finally it was observed that the film passivates when an anodic current is run for a long period of time. The electrode under a microscope was found to consist of a layer of porous silver. This would give a large surface area and partly explain the large capacitances observed. The data taken on the completed apparatus indicated a value for the double layer capacitance on a silver

electrode of approximately 60 ma/cm^2. A preliminary set of runs to determine the kinetics of the silver chloride reaction gave straight line plots according to theory, but the slopes of the lines were not the same for the various values of the currents used.

2513

Princeton U. [Dept. of Electrical Engineering] N. J.

ON COMPLETENESS OF BASIS FUNCTIONS USED FOR SIGNAL ANALYSIS, by P. R. Clement [1962] [9]p. (AFOSR-J923) (AF AFOSR-62-312) AD 416556 Unclassified

Also published in SIAM Rev., v. 5: 131-139, Apr. 1963.

Some of the classical results relating to the questions of completeness and closure in the theory of approximation are presented. Furthermore, some applications of these results are made. The choice of a set of basic functions is guided by the characteristics of the class of functions to be approximated, and if physical implementation of an approximating model in an analog sense, should be made by considerations in network synthesis theory. The latter problem is not treated.

2514

Princeton U. Dept. of Mathematics, J. J.

ON AXIOMATIC HOMOLOGY THEORY, by J. Milnor. [1961] [5]p. [AF 49(638)431] Unclassified

Also published in Pacific Jour. Math., v. 12: 337-341, Spring 1962.

The main object of this note is to show that there is essentially only one additive homology theory and one additive cohomology theroy, with given coefficient group, on the category $\mathcal{W}$.

2515

Princeton U. [Dept. of Mathematics] N. J.

ENTIRE FUNCTIONS IN SEVERAL VARIABLES WITH CONSTANT ABSOLUTE VALUES ON A CIRCULAR UNIQUENESS SET, by S. Bochner. [1961] [5]p. (AFOSR-J324) (AF 49(638)578) Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 117-120, Feb. 1962.

The author generalizes a result of R. Benjanic and W. Stoll in proving that if for an entire function we have $|f(\zeta)| = 1$ on a set S then f(z) is a homogeneous polynomial. The general point set S has the following properties: (1) S is circular, that is, if $(\zeta_1, \ldots, \zeta_n) \in S$, then also $(\zeta_1 t, \ldots, \zeta_n t) \in S$ for any $|t| = 1$; (2) S is connected; (3) S is a uniqueness set for entire functions, in the sense that if f(z) is 0 on S it is $\equiv 0$. The author obtains the precise function of f and applies his results to definite functions in the matrix space.

2516

Princeton U. [Dept. of Mathematics] N. J.

THE ROLE OF MATHEMATICS IN THE RISE OF MECHANICS, by S. Bochner. [1962] [18]p. (AFOSR-J326) (AF 49(638)578) Unclassified

Also published in Amer. Scientist, v. 50: 294-311, June 1962.

Some observations are made on the mathematical nature of mechanics. The Greeks had a systematic mathematical astronomy but outside of this they seemingly did not arrive at a theoretical mechanics or theoretical physics that was equal in status to their mathematics. Their mechanics was only an assortment of achievements. Modern mechanics came into being soon after the Renaissance. The seventeenth century in mechanics extended from Stevin to Newton and culminated in Newton's Principia. The eighteenth century extended from Newton and Leibniz to Lagrange and culminated in his Mecanique analytique, the nineteenth century in mechanics extended from Lagrange and Laplace up to the stirrings of quantum theory in 1900. In the twentieth century, the leading new theories of mechanics became more than before, direct and full representatives of the new physical theories of which they are a part and can hardly be isolated from them for separate analyses. To characterize them: the seventeenth century was an age of revelation, the eighteenth century was an age of patristic organization, and the nineteenth century was an age of canonical legislation.

2517

Princeton U. Dept. of Mathematics, N. J.

A NEW APPROACH TO ALMOST PERIODICITY, by S. Bochner. [1962] [5]p. (AFOSR-J517) [AF 49(638)578] AD 415315 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 2039-2043, Dec. 1962.

Six theorems on almost periodic and almost automorphic functions are presented and discussed. Various theorems of P. Bohl, H. Bohr, O. Neugebauer, J. Favard, S. Bochner, and others are subsumed for portions of this work.

2518

Princeton U. [Dept. of Mathematics] N. J.

COHOMOLOGY OPERATIONS, by N. E. Steenrod and D. B. A. Epstein. Princeton University Press, Princeton. 1962, 138p. (Annals of Mathematics Studies no. 50) (AF AFOSR-62-193) Unclassified

As the first book on cohomology operations, this volume contains lectures given by the creator of the operations known as Steenrod squares Sq^i and the pth reduced powers P^i, where i = 0, 1... and p is a prime number. There are 8 chapters, together with an appendix,

2519

Princeton U. [Dept of Psychology] N. J.

PSYCHOPHYSICS OF TIME-VARIANT STIMULI: THE ABSOLUTE THRESHOLD FOR ACCELERATED MOTION, by R. D. L. Filion. [1962] [45]p. incl. diagrs. tables, refs. (AFOSR-2521) (AF 49(638)381) Unclassified

The utility of basic threshold determinations for accelerated motion was noted, especially within the context of a servo-system model of behavior which emphasized the sensitivity of organisms to time-variant stimuli. Thresholds were obtained using both accelerated and constant-velocity motion displayed on an oscilloscope. It was found that the absolute threshold for acceleration, and the difference threshold for velocities resulting from accelerated velocity, were unusually high. Graphic analysis showed that neither a fixed value of acceleration, for a fixed velocity increment, nor a constant Weber fraction $\frac{(\Delta V)}{V}$ could account for the threshold values obtained under all conditions of display size and initial velocity. Suggestions and comments were made concerning modifications of experimental design for future research.

2520

Princeton U. Dept. of Psychology, N. J.

VISUAL VELOCITY DISCRIMINATION: EFFECTS OF SPATIAL AND TEMPORAL CUES, by F. J. Mandriota, D. E. Mintz, and J. M. Notterman. [1962] [2]p. (AFOSR-J185) (AF 49(638)381) AD 400178 Unclassified

Also published in Science, v. 138: 437-438, Oct. 19, 1962.

Weber ratios were obtained for visual velocity discrimination under 3 topographic conditions with the same subjects and psychophysical procedures. The conditions differed regarding the presence of either temporal or spatial cues, these being correlated in magnitude with stimulus velocity. Systematic effects of the cues upon the level of velocity discrimination were noted. (Contractor's abstract)

2521

Princeton U. [Dept. of Psychology] N. J.

SITES OF INTERFERENCE IN A MULTI-UNIT IDENTIFICATION TASK, by R. M. Gagne and J. M. Fleming. [1962] [11]p. incl. diagrs. tables. (AF AFOSR-62-197) Unclassified

Published in Psychol. Repts., v. 11: 765-775, Dec. 1962.

A study was undertaken to determine the amount and location (site) of interference when new units are added to a previously learned identification task. The tasks used involved nonsense figures projected by slides as stimuli, and responses made to spring-return toggle switches on a sloping panel. Interference was measured as overt errors, and also in terms of time of response. A total of 5 groups of high-school boys, 10 in each group, participated in the experiment. An original set of 3 groups each learned a 4-unit identification task, followed by the learning of an augmented task composed of the original 4 units plus 2, plus 4, and plus 6, respectively. Two additional groups learned tasks as follows: 2 units, plus 4 units; 6 units, plus 4 units. The object was to measure how much interference occurred, in the second task, among the "old" units as compared with the "new" ones. The results were as follows: (1) Interference, as revealed by time scores, increased more rapidly within the "new" units than within the "old", as more were added to the original 4-unit task. (2) Interference among "new" units of the augmented task was in all cases significantly less than among the same number of units in original learning, but increased at approximately the same rate with number of units, (3) As measured by overt errors, interference of the "intra-task" variety was moderate within the "old" units of the second task, highest within the "new" units. In contrast, importations between old and new units occurred with low frequency in both directions, and (4) The occurrence of interference was compared for 2 total tasks of 6 and 10 units, learned in the sequences 2 plus 4 and 4 plus 2; and 4 plus 6 and 6 plus 4. When the larger task was learned first, the amount of interference in the second (augmented) task was quite low. However, when the total interference was compared, no significant differences between the 2 different sequences were found. The results are discussed in terms of their general significance for the operation of interference in identification learning and for the efficiency of various learning sequences.

2522

Princeton U. Frick Chemical Lab., N. J.

RHEOLOGY OF POLYTETRAFLUOROETHYLENE, by A. V. Tobolsky, D. Katz, and M. Takahashi. [1961] [7]p. incl. diagrs. tables. [AF 49(638)974] Unclassified

Published in Jour. Polymer. Sci., Part A, v. 1: 483-489, Jan. 1963.

The rheology of polytetrafluoroethylene above its melting point was studied by the technique of stress relaxation. The temperature shift for the maximum relaxation time at various temperatures fits the WLF equation, if the value of T_g is taken to be 110°C. Degradation of the polymer becomes appreciable above 380°C. Master stress relaxation curves were constructed from the data between 336° and 380°C. The continuous distribution of relaxation times was obtained, and also the discrete distribution of relaxation times by procedure X. The contribution of the maximum relaxation time to the total flow viscosity indicates that the molecular weight distribution of the sample used was narrow.

2523

Princeton U. Palmer Physical Lab., N. J.

GRAVITATIONAL FIELD ENERGY AND g_{00}, by C. W. Misner. [1962] [12]p. incl. refs. (AFOSR-4529) (AF 49(638)304) Unclassified

Also published in Phys. Rev., v. 130: 1590-1594, May 15, 1963.

It is shown that one of the family of "generalized energy density" definitions being investigated by Komar, one for which the generalized energy density is made positive definite by use of minimal surfaces, leads to a total "generalized energy". This "generalized energy" is: (a) undefinable for closed universes, (b) not conserved for some asymptotically flat spaces, and (c) not the correct total energy for the Oppenheimer-Snyder collapsing star metric where the metric in a neighborhood of infinity is identically the Schwarzschild metric.

2524

Princeton U. Palmer Physical Lab., N. J.

WAVES NEWTONIAN FIELDS, AND COORDINATE F FUNCTIONS, by C. W. Misner. July 1962, 22p. incl. refs. (AFOSR-4530) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)304 and National Science Foundation) Unclassified

Presented at Conf. on Relativistic Theories of Gravitation, Warsaw (Poland), July 1962.

Three topics are discussed concerning fields in the neighborhood of infinity in asymptotically flat spaces: (1) the wave-front theorem which shows that the flux of energy decreases faster than $1/r^3$ on any t = constant surface of an asymptotically rectangular coordinate system in an asymptotically flat space; (2) the identification of total energy-momentum P^μ and the coordinate invariant P^μ/r asymptotic behavior of specific "Newtonian" components of the metric; (3) the definition of "gauge scalar" wave amplitudes which describe gravitation radiation escaping to infinity (or short waves in any weak field region). In addition there is brief mention of quantum theory and some indications that spacelike surfaces might exist in a quantized geometry.

2525

Princeton U. Palmer Physical Lab., N. J.

COMPLEX ANGULAR MOMENTA IN POTENTIAL SCATTERING, by M. Froissart. [1962] [6]p. (AFOSR-5115) (AF 49(638)304) Unclassified

Also published in Jour. Math. Phys., v. 3: 922-927, Sept.-Oct. 1962.

The S matrix associated with a central potential is shown to be meromorphic in the energy and angular momentum variables under very broad conditions. The domain of meromorphy contains the product of a domain in the energy variable by a domain in the angular variable. The former (latter) domain has a very simple connection with the domain of meromorphy of the Laplace (Mellin) transform of the potential with respect to the radius. (Contractor's abstract)

2526

Princeton U. Palmer Physical Lab., N. J.

THREE-DIMENSIONAL GEOMETRY AS CARRIER OF INFORMATION ABOUT TIME, by R. F. Baierlein, D. H. Sharp, and J. A. Wheeler. [1962] [2]p. (AFOSR-J786) (AF 49(638)304) AD 407730 Unclassified

Also published in Phys. Rev., v. 126: 1864-1865, June 1, 1962.

A geometry of curved empty space which evolves in time in accordance with Einstein's field equations may be termed a "geometrodynamical history." Such a history can be specified by giving on a 3-dimensional space-like hypersurface ("initial surface") (1) the geometry intrinsic to this surface and (2) the extrinsic curvature of this surface. However, the intrinsic and extrinsic curvatures of the surface cannot be specified independently, but have to satisfy the initial value equations of Foures and Lichnerowicz (analogous to div E = O and div B = O in electromagnetism). An alternate way of specifying a history is outlined in which the intrinsic geometry is given freely on each of 2 hypersurfaces, and nothing is specified as to the extrinsic curvature of either. In the special case in which the 2 so-specified 3-geometries are nearly alike--a procedure is outlined in order to find the following from Einstein's equations: (1) the invariant space-time interval between an arbitrary point on one surface and a nearby point on the other surface (and thus the 4-geometry interior to the thin sandwich); (2) the extrinsic curvature of the sandwich; hence (via the rest of Einstein's equations) (3) the entire enveloping 4-geometry or geometrodynamical history); and finally (4) the time-like separation of the original surfaces and their location in spacetime. In this sense two 3-geometries carry latent information about time. (Contractor's abstract)

2527

Princeton U. [Palmer Physical Lab.] N. J.

THE PROBLEM OF MEASUREMENT, by E. P. Wigner. [1962] [10]p. incl. diagr. refs. (AFOSR-J788) (AF 49-(638)304) AD 413381 Unclassified

Also published in Amer. Jour. Phys., v. 31: 6-15, Jan. 1963.

The standard theory of measurements in quantum mechanics is reviewed with special emphasis on the conceptual and epistemological implications. It is concluded that the standard theory remains the only one which is compatible with present quantum mechanics. Hence, if one wants to avoid the conclusion that quantum mechanics only gives probability connections between

subsequent observations, the quantum-mechanical equations would have to be modified. Particular attention is paid to the case that the measuring apparatus is macroscopic and its state vector not accurately known before the measurement. (Contractor's abstract)

2528

Princeton U. Palmer Physical Lab., N. J.

THE UNIVERSE IN THE LIGHT OF GENERAL RELATIVITY, by J. A. Wheeler. [1962] [37]p. (AFOSR-J789) (AF 49(638)304) AD 411442 Unclassified

Also published in Monist, v. 47: 40-76, Fall 1962.

It is noted that in various symposia on relativity there are 2 trends: (1) Interest has fallen in inventing new theories of gravitation, spacetime, and the expanding universe; and (2) Increasing numbers of investigators share the conviction that Einstein's 1915-1916 analysis of the curvature of space by energy is a unique theory of unrivalled scope and reasonableness, against which no objection of principle or observation has even been sustained, and out of which one should now try to read the deeper meaning and consequences. It is concluded that general relativity plus the quantum principle, where necessary supplies a rationale for cosmology. The study of the dynamical evolution of a geometrodynamical model universe has already provided some guidance in understanding the properties of the real universe. However, there are many fascinating and still unsolved questions of principle connected with the development of such a curved empty space. Further straight-forward analysis of the consequences of general relativity and the quantum principle appears to be the route most likely to lead to a clearing up of these issues and to new insight into the past and future of the universe.

2529

Princeton U. [Palmer Physical Lab.] N. J.

THE SCIENTIST: HIS INCREASED RESPONSIBILITIES, by M. W. Wigner and E. P. Wigner. [1962] [7]p. (AFOSR-J790) (AF 49(638)304) AD 411286 Unclassified

Published in Hungarian Quart., v. 3: 1-7, Apr.-July 1962.

The new tasks confronting physical scientists can be grouped rather loosely into 3 categories, none of which can be completely separated from the others nor from the scientist's traditional occupations of teaching and research. They comprise first, technical work for the economy and defense of the country; secondly, service in governmental positions or committees, furnishing information and advice of a scientific nature concerning new projects problems in international tensions, and finally, participation and leadership in efforts to lessen international tensions, a responsibility arising from the unique position of the scientist in world affairs.

2530

Princeton U. Palmer Physical Lab., N. J.

PIONIC NUCLEI, by R. F. Peierls and S. B. Treiman. [1962] [3]p. (AFOSR-J792) (AF 49(638)304) AD 413691 Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 339-341, Apr. 1962.

Explanations of the near equality of the η^0 and ζ masses are presented. The η^0 and ζ are interpreted as loosely-bound nuclei made up of 4π, with quantum numbers that forbid $2\text{-}\pi$ and $3\text{-}\pi$ decays in the absence of electromagnetic interactions. For the η^0, this is consistent with the 0^{-+} quantum number assignment. The quantum numbers 0^{++} (I = 1) are assigned to the ζ, and implications are discussed.

2531

Princeton U. Palmer Physical Lab., N. J.

FURTHER RESULTS IN TOPOLOGICAL RELATIVITY, by D. Finkelstein and C. W. Misner. [1962] [5]p. incl. diagr. (AFOSR-J795) (AF 49(638)304) AD 408795 Unclassified

Also published in Colloq. Internationaux du Centre Nat'l. de la Recherche Scientifique; Les Théories Relativistes de la Gravitation, Royaumont (France) (June 21-27, 1959), Paris, CRNS, No. 91: 409-413, 1962.

The basic question that has stimulated these researches into topological questions is, can a purely gravitic structure conceivably have half-integer spin? It includes further properties of an interesting by-product of the program, the <<M geon>>.

2532

Princeton U. Palmer Physical Lab., N. J.

ADAIR SPIN ANALYSIS WITH PARITY NONCONSERVATION, by S. B. Treiman. [1962] [1]p. (AFOSR-J796) [AF 49(638)304] AD 413401 Unclassified

Also published in Phys. Rev., v. 128: 1342, Nov. 1, 1962.

A variation of the Adair spin analysis is considered for an unstable boson produced in association with a hyperon whose decay violates parity conservation. (Contractor's abstract)

2533

Princeton U. Palmer Physical Lab., N. J.

SOME EXPERIMENTAL CONSEQUENCES OF TRIANGLE

SINGULARITIES IN PRODUCTION PROCESSES, by P. V. Landshoff and S. B. Treiman. [1962] [4]p. incl. diagrs. (AFOSR-J805) (AF 49(638)304) AD 413491 Unclassified

Also published in Phys. Rev., v. 127: 649-652, July 15, 1962.

The infinite anomalous threshold singularities in the amplitude for a production reaction may, in certain circumstances, lie close to the physical region. The possibility then arises that they can be 'detected' through characteristic peaking effects which they produce, as sometimes happens for the more familiar pole-type singularities. Examples based on triangle graphs are discussed. (Contractor's abstract)

2534

Princeton U. Palmer Physical Lab., N. J.

REGGE POLES IN HIGH-ENERGY ELECTRON SCATTERING, by R. Blankenbecler, L. F. Cook, Jr., and M. L. Goldberger. [1962] [13]p. incl. diagrs. refs. (AFOSR-J811) (AF 49(638)304) AD 413504 Unclassified

Also published in Phys. Rev., v. 128: 2440-2454, Dec. 1, 1962.

The possibility that the photon is described by a Regge trajectory is considered, and the effect of this assumption on the analysis of electron-pion, electron-nucleon, and electron-helium scattering is examined in some detail. Partial-wave projections for the various amplitudes are made in the annihilation channel, and a multiparticle unitarity condition is formally imposed by use of the N/D matrix formulation. Since the photon does not have a fixed spin of one, the spin matrix structure is considerably more complicated than in the conventional theory. The amplitudes are written in terms of the Regge poles corresponding to the photon, ρ-ω meson, etc., and the resulting cross sections are given in the interesting high-energy limit. The essential change due to the Regge behavior of the photon is an over-all nonintegral power of the energy occurring in the cross section. The effect of this factor can be experimentally tested and this possibility is discussed.

2535

Princeton U. Palmer Physical Lab., N. J.

IS THE PHOTON AN ELEMENTARY PARTICLE? by R. Blankenbecler, L. F. Cook, and M. L. Goldberger. [1962] [3]p. (AFOSR-J812) (AF 49(638)-304) AD 413537 Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 463-465, June 1, 1962.

The photon is associated with the Regge trajectory with odd signature which has the property $\alpha_1(0) = 1$, corresponding to a spin-one and zero-mass physical particle. The Regge analysis gives in the electron-pion or electron-proton scattering additional form factors and energy dependence of cross section. The possibility of experimental detection of the break-downs of electrodynamics is discussed.

2536

Princeton U. Palmer Physical Lab., N. J.

PROBLEMS ON THE FRONTIERS BETWEEN GENERAL RELATIVITY AND DIFFERENTIAL GEOMETRY, by J. A. Wheeler. [1962] [20]p. incl. table. (AFOSR-J814) (AF 49(638)304) AD 413593 Unclassified

Also published in Rev. Modern Phys., v. 34: 873-892, Oct. 1962.

This review is adapted from a report presented at the 1962 American Mathematical Society Institute on Relativity and Differential Geometry at Santa Barbara. The principal part reviews some exact solutions, describes new insights that they lead to, and places these in the context of modern problems in differential geometry. Historical and theoretical discussion of general relativity is given.

2537

Princeton U. Palmer Physical Lab., N. J.

ELEMENTARY PARTICLES OF CONVENTIONAL FIELD THEORY AS REGGE POLES, by M. Gell-Mann and M. L. Goldberger. [1962] [3]p. incl. refs. (AFOSR-J818) (AF 49(638)304) AD 413697 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 275-277, Sept. 15, 1962.

Conventional field theory is examined in low order perturbation theory. To all the fourth order of PS-PS pion-nucleon theory, it is shown that all the angular momentum poles vary with energy except for the nucleon pole. However, the Regge nature of the nucleon is implied from the study of the radiative corrections to it by a virtual neutral vector meson. The paths of the trajectories so calculated show many of the characteristics expected from the Regge formalism. This indicates that the Regge pole boundary conditions might be contained in conventional field theory as well as in the dispersion relation approach.

2538

Princeton U. Palmer Physical Lab., N. J.

HIGH-ENERGY GAMMA RAYS AND LOW-ENERGY PROTONS AND DEUTERONS FROM C^{12} + p FOR E_p = 14-20 MEV, by E. K. Warburton and H. O. Funsten. [1962] [10]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)920], Atomic Energy Commission, and Higgins Scientific Trust Fund) Unclassified

Published in Phys. Rev., v. 128: 1810-1819, Nov. 15, 1962.

The 90° yield of gamma rays from proton bombardment of C^{12} was studied for proton energies between 14 and 20 mev. Gamma rays are observed corresponding to the ground-state decay of the C^{12} 4.43-, 12.7-, and 15.1-mev levels and from the $C^{12}(p,\gamma 0)N^{13}$ reaction. Three resonances are observed in the yield of the 15.1-mev gamma ray. These resonances correspond to N^{13} levels at 18.1, 18.65, and 19.8 mev. The N^{13} 18.1-mev level has a width of 330 ± 100 kev in the center-of-mass system. The other 2 levels have widths less than 200 kev. The yields of the 4.43- and 12.7-mev gamma rays reveal little or no structure. The excitation function of the $C^{12}(p,\gamma 0)N^{13}$ reaction also shows little structure. Angular distributions and absolute integrated cross sections for the $C^{12}(p,p')C^{12}$ reaction are given for the C^{12} 12.7-mev level with E_p = 17.5, 19.5, and 20 mev and for the C^{12} 15.1-mev level with E_p = 19.5 mev. The latter is approximately symmetrical about 90° which suggests possible contribution from the compound nucleus reaction mechanism. Comparison of the cross sections for $C^{12}(p,p'\gamma)C^{12}$ and $C^{12}(p,p')C^{12}$ gives $\Gamma_\gamma/\Gamma = 0.027 \pm 0.007$ for the C^{12} 12.7-mev state and 1.15 ± 0.3 for the C^{12} 15.1-mev state. The yield of the $C^{12}(p,d)C^{11}$ reaction was measured by the stacked foil technique from threshold (E_p = 17.85 mev) to 19.8 mev. There is no evidence for structure. Angular distributions are given for the $C^{12}(p,d)C^{11}$ reaction for E_p = 19.3, 19.5, and 20.0 mev. The results are compared to previous work on the $B^{11}(d,n)C^{12}$ reaction and it is concluded that the contribution of the compound nucleus reaction mechanism to either reaction is most likely small for the bombarding energies in question. (Contractor's abstract)

2539

Princeton U. Palmer Physical Lab., N. J.

PULSE SHAPE DISCRIMINATION IN P-N JUNCTION DETECTORS, by H. O. Funsten. [1962] [3]p. incl. diagrs. [AF 49(638)920] Unclassified

Presented at Eighth Scintillation Counter Symposium, Washington, D. C., Mar. 1-3, 1962.

Published in I. R. E. Trans. on Nuclear Sci., v. NS-9: 190-192, June 1962.

A pulse shape discrimination circuit for solid state particle detectors has been developed that will distinguish between ionizing particles stopping completely within the junction region and those passing beyond. It is based upon the fact that the first kind of particles produces a fast rising pulse in the order of nanosec whereas the second kind has an added diffusion component in the μsec region. A circuit description and representative spectra are given.

2540

Princeton U. Palmer Physical Lab., N. J.

CONCERNING THE NOTION OF TIME INTERVAL IN S-MATRIX THEORY, by M. L. Goldberger and K. M. Watson. [1962] [3]p. incl. diagr. (AFOSR-J18) (In cooperation with California U., Berkeley) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-390 and Atomic Energy Commission) AD 400384 Unclassified

Also published in Phys. Rev., v. 127: 2284-2286, Sept. 15, 1962.

For abstract see item no. 322, Vol. VI.

2541

Puerto Rico U. [Dept. of Electrical Engineering] Mayaguez.

STUDY OF SPORADIC E AND OTHER FORMS OF IONIZATION, by [B. Dueno]. Interim final rept. [1962] [8]p. incl. table. (AFOSR-3278) (AF 49(638)172) Unclassified

A Granger Model 902 Step Frequency Ionospheric Sounder was used to record data, every 5 min on 35 mm film, which was compared to data on the total component of the earth's magnetic field obtained by means of a Varian Rubidium Vapor Magnetometer. Preliminary results seem to indicate that there exists a relationship between sizable magnetic disturbances and Sporadic E. First, the solar magnetic variation on quiet days of the geomagnetic components in the middle latitudes are augmented during the summer season, and second, Sporadic E as observed by backscatter from Puerto Rico has been found to be most prevalent in the due south direction thus suggesting some sort of geomagnetic control. One clue that Sporadic E may not be independent of magnetic activity was furnished by the radio fade out which occurred on Apr. 27, 1962 due to a solar flare. This caused a depression of the magnetic field of approximately 4 γ.

2542

Purdue U. Dept. of Chemistry, Lafayette, Ind.

RARE EARTH OXIDE SYSTEMS. THE HYSTERESIS EFFECTS IN PRASEODYMIUM OXIDE, by P. A. Faeth and A. F. Clifford. [1962] [5]p. incl. diagrs. refs. (AFOSR-J1105) (AF 18(603)45) AD 420934 Unclassified

Also published in Jour. Phys. Chem., v. 67: 1453-1457, July 1963.

For abstract see item no. 2442, Vol. V.

2543

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE INFRARED SPECTRA OF PRASEODYMIUM OXIDE

AND PRASEODYMIUM CARBONATE, by A. F. Clifford and P. A. Faeth. [1962] [12]p. incl. diagrs. table, refs. (AF 18(603)45) Unclassified

Published in Rare Earth Research; Proc. of the Second Conf., Glenwood Springs, Colo. (Sept. 24-27, 1961), ed. by J. F. Nachman and C. E. Lundin. Gordon and Breach, New York, 1962. p. 35-46.

Several samples of PrO_x have been prepared which have x values $1.50 < x < 1.83$; by decomposing $PrO_{1.83}$ in vacuo any x value could be prepared. The preparations were analyzed for infrared-absorption acitvity in the region 2-16 μ. An absorption band at about 15 microns appeared for all samples if the specimens were permitted access to the atmosphere. No band appeared in this region if the samples were analyzed immediately after their preparation. Infrared analysis of samples of praseodymium carbonate and praseodymium hydroxide showed absorption activity in the same regions where activity was noted for air-exposed praseodymium oxide samples. It is concluded that the absorption band at 15 μ for the air-exposed oxides is due to hydration-carbonation effects. The band is probably indicative of a metal-oxygen bond as proposed by Meloche for oxide systems; the band might also be due to a chemisorbed species (CO_2 or H_2O). A sample of praseodymium carbonate was decomposed in vacuo and the spectrum of the resultant compound was observed. A differential thermal analysis (DTA) of the carbonate in air showed that the dehydration probably is complete below 300°; the carbonate loses CO_2 at 470° and 630°C and is subsequently converted to the oxide Pr_6O_{11} near 400°C.

2544

Purdue U. Dept. of Chemistry, Lafayette, Ind.

APPLICATION OF COORDINATION KINETICS TO THE SEPARATION OF METAL IONS: COORDINATION KINETIC CHROMATOGRAPHY, by D. W. Margerum. Final rept. Mar. 1962, 10p. incl. refs. (AFOSR-2721) (AF 49(638)60) Unclassified

Investigations of the kinetics of coordination complexes have yielded the discovery of the first coordination chain reaction. These chain reactions offer the possibility of metal complexes serving as ligand selectors and chemical amplifiers. Such reactions may be of great importance in ascertaining the role of trace metals in metalloenzymatic systems. The coordination chain reactions also may be utilized in ultratrace analysis of ligands of metal ions because of the extreme sensitivity of the reaction rate to the concentration of these stable chain propagations. Multidentate complexes with steric hindrance are found which are not attacked by other metal ions or other multidentate complexes. These complexes appear to be among those most suitable for kinetic separations and the initially proposed application still looks promising as a general technique; however, in the course of this study other applications of the coordination chain reactions to both analyses and to an examination of the role of metals in enzymatic systems appears to be of even greater importance.

2545

Purdue U. Dept. of Chemistry, Lafayette, Ind.

COORDINATION KINETICS BY ION EXCHANGE, by D. W. Margerum and B. A. Zabin. [1962] [5]p. incl. diagrs. refs. (AFOSR-J7) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)60 and Monsanto Chemical Co.) AD 400087 Unclassified

Also published in Jour. Phys. Chem., v. 66: 2214-2218, Nov. 1962

Cation-exchange resin is used as a metal ion buffer to give very low but constant concentrations of metal ions in order to control the rate of fast coordination reactions in the solution phase. The rate of formation of nickel(II)-EDTA is used to test 2 variations of the system. Particle diffusion rates limit the magnitude of the coordination rate constants which can be measured. The fraction of resin in the hydrogen ion form compared to sodium ion form has an unexpectedly large effect on the diffusion of nickel ion under conditions of low nickel loading where the coupled resin diffusion process should depend largely on the self-diffusion constant of nickel ion.

2546

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. II. ZINC(II) AND ETHYLENEDIAMINETETRAACETATONICKELATE(II) WITH COPPER(II) CATALYSIS, by D. W. Margerum and T. J. Bydalek. [1962] [5]p. incl. tables. (AFOSR-J9) (AF 49(638)60) AD 400388 Unclassified

Also published in Inorg. Chem., v. 1: 852-856, Nov. 1962.

The Zn^{+2} substitution reaction with nickel-EDTA[1] is 1/6500 times as fast as the corresponding Cu^{+2} reaction at 25.0°. However, the same type of kinetic expression is found for Zn^{+2} and Cu^{+2} as contrasted to radionickel exchange and their relative rate constants permit the path of this type of substitution reaction to be characterized. A dinuclear reaction intermediate is proposed with an iminodiacetate segment of EDTA coordinated to the attacking metal ion. The catalysis of the Zn^{+2} reaction by traces of Cu^{+2} is studied. (Contractor's abstract)

2547

Purdue U Dept. of Chemistry, Lafayette, Ind.

COORDINATION CHAIN REACTIONS. EXCHANGE BETWEEN ETHYLENEDIAMINETETRACETATOCUPRATE(II) AND TRIETHYLENETETRAMINENICKEL(II), by D. C. Olson and D. W. Margerum. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J693) (AF 49(638)60) AD 415063 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 297-303, Feb. 5, 1963.

A chain reaction mechanism is proposed for the exchange

of triethylenetetramine and ethylenediaminetetraacetate between their nickel(II) and copper(II) complex. This exchange proceeds at a much faster rate than the aqueous dissociation rate of these complexes. The chain reaction is initiated by a trace of either of these multidentate ligands. In the chain-propagation steps, one multidentate ligand displaces another from the metal complex and vice versa. Very sensitive control of the reaction rate is possible because the chain propagators are stable ligands whose concentration can be adjusted. Metal ions terminate the chain and the reaction can be used for trace metal determination.

2548

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. III. THE FORMATION AND DISSOCIATION OF TRIETHYLENETETRAMINENICKEL(II) AND TETRAETHYLENEPENTAMINENICKEL(II) AND THEIR EXCHANGE WITH RADIONICKEL ION, by D. W. Margerum, D. B. Rorabacher, and J. F. G. Clarke, Jr. Oct. 1962 [11]p. incl. diagrs. tables, refs. (AFOSR-64-1405) (AF 49(638)60) AD 444458 Unclassified

Also published in Inorg. Chem., v. 2: 667-677, Aug. 1963.

The kinetics of the formation and dissociation reactions of triethylenetetraminenickel(II) and of tetraethylenepentaminenickel(II) as well as their exchange reactions with radionickel ion have been studied at 25°, μ = 0.1 pH 4.5 to 7.5, using spectrophotometric, titrigraphic, and radiochemical methods. It is proposed that these 4- and 5-dentate ligands react with nickel by the stepwise formation of coordinate bonds, where the rate-determining step is the formation of the first Ni-N bond and the subsequent bonding is rapid. Similarly, the dissociation mechanism proposed involves the preequilibration of intermediately bonded species leading to the rate step of breaking the last Ni-N bond. On this basis, it is possible to estimate the equilibrium constants for each of the reaction intermediates. The differences in the reaction-rate constants of the straight-chain polyamines (having from 2 to 6 nitrogens), as well as their protonated species, can be attributed entirely to statistical and electrostatic effects. This model should be applicable to complexes containing other metal ions and other unbranched multidentate ligands. (Contractor's abstract)

2549

Purdue U. Dept. of Chemistry, Lafayette, Ind.

SOLVATION AS A FACTOR IN THE ALKYLATION OF AMBIDENT ANIONS: THE IMPORTANCE OF THE HYDROGEN BONDING CAPACITY OF THE SOLVENT, by N. Kornblum, P. J. Berrigan, and W. J. Le Noble. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-1831) (AF 49(638)324) AD 416521 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1141-1147, Apr. 20, 1963.

When solutions of the salts of phenol or p-alkylphenols in a wide variety of solvents are alkylated with allyl or benzyl halides, the ether (oxygen alkylation) is the sole product. However, when these reactions are conducted in water, phenol or fluorinated alcohols, substantial amounts of o- and p-alkylated products result. Neither carbon nor oxygen alkylation is a carbonium ion process but, rather, these are second-order nucleophilic displacements. An explanation for the fact that water, phenol and fluorinated alcohols foster carbon alkylation, which invokes their strong hydrogen bonding capabilities, is proposed.

2550

Purdue U. Dept. of Chemistry, Lafayette, Ind.

SOLVATION AS A FACTOR IN THE ALKYLATION OF AMBIDENT ANIONS: THE IMPORTANCE OF THE DIELECTRIC FACTOR, by N. Kornblum, R. Seltzer, and P. Haberfield. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J845) (AF 49(638)324) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1148-1154, Apr. 20, 1963.

Solutions of sodium 8-naphthoxide in a variety of solvents have been alkylated with benzyl bromide, methyl iodide and n-propyl bromide. The results of these studies provide a clear demonstration of the ability of the solvent to decide the course of an ambident anion reaction. A discussion of solvent effects on the course of ambident anion processes is presented which distinguishes between protic and aprotic solvents and which emphasizes the utility of this distinction. As a consequence, it is now possible to correlate the dielectric constant of an aprotic solvent with its influence on the alkylation process. Finally, the interdependence of solvent and cation effects is explicitly recognized and employed so that insights concerning the ability of solvents to determine the course of ambident anion reactions are obtained.

2551

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE STEREOCHEMISTRY OF THE NUCLEOPHILIC ADDITION OF p-TOLUENETHIOL TO 1-p-TOLYLSULFONYLCYCLOPENTENE, by W. E. Truce and A. J. Levy. [1962] [4]p. incl. refs. (AFOSR-2729) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)531 and American Cyanamid Co.) AD 413842 Unclassified

Also published in Jour. Org. Chem., v. 28: 679-682, Mar. 1963.

Under mildly basic conditions, p-toluenethiol adds to 1-p-tolylsulfonylcyclopentene to give trans-2-p-tolylmercapto-1-p-tolylsulfonylcyclopentane. The stereochemistry of the adduct was proved by an independent synthesis. An explanation, together with supporting evidence, for the stereoselectivity involved is given. (Contractor's abstract)

2552

Purdue U. Dept. of Chemistry, Lafayette, Ind.

A CONVENIENT SYNTHESIS OF AROMATIC AND ALIPHATIC SODIUM SULFINATES, by W. E. Truce and F. E. Roberts, Jr. [1962] [2]p. incl. refs. (AFOSR-J374) (AF 49(638)531) AD 408602 Unclassified

Also published in Jour. Org. Chem., v. 28: 593-594, Feb. 1963.

A method of converting thiols to the corresponding Na sulfinates in good yield was reported. The thiols were prepared from acrylonitrile. The β-aryl- or alkylthiopropionitriles were oxidized to the sulfones in good yield. β-p-tolylsulfonylpropionitrile (4g) suspended in 50 ml of alcohol was treated with 10 ml of alcohol, 0.44g Na, and 1.45g 1-propanethiol. The mixture was refluxed 5 hr, evaporated, and the solid suspended in Et_2O and filtered off to give 3.1g of Na 1-propanethiolate. Acidification gave the free sulfinic acid, mp 81-83°. The ethereal residue contained β-propylthiopropionitrile. Similarly, β-propylsulfonyl-propionitrile gave 58% benzyl Pr sulfone, mp 87-89°. Thus reaction of Et β-p-tolylsulfonylacrylate with Na thiophenoxide gave a mixture of the Et cis- and trans-β-phenylthioacrylate.

2553

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE METALATION AND ALKYLATION OF MERCAPTALS, by W. E. Truce and F. E. Roberts [Jr.]. [1962] [4]p. incl. refs. (AFOSR-J606) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)531 and Army Research Office (Durham)) AD 414006 Unclassified

Also published in Jour. Org. Chem., v. 28: 961-964, Apr. 1963.

The formation of a mercaptal anion and its reaction with various alkylating and acylating agents was studied. The conversion of the alkylated and acylated products into carbonyl compounds can serve as a source of mono-ketones, α-diketones, acylions, α-keto esters, and β-keto esters. A new desulfurizing system is discussed. (Contractor's abstract)

2554

Purdue U. Dept. of Chemistry, Lafayette, Ind

THE PRODUCTS OF THE REACTIONS OF SODIUM t-BUTYLMERCAPTIDE WITH VINYL CHLORIDE, VINYLIDENE CHLORIDE, AND CIS- AND TRANS-DICHLOROETHYLENES, by J. Flynn, Jr., V. V. Badiger, and W. E. Truce. [1962] [5]p. incl. refs. (AFOSR-K1098) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)531 and National Science Foundation) AD 420832 Unclassified

Also published in Jour. Org. Chem., v. 28: 2298-2302, Sept. 1963.

The products of the reactions of alcoholic sodium t-butylmercaptide with vinyl chloride, vinylidene chloride, and cis- and trans-dichlorethylenes are described.

2555

Purdue U. Dept. of Chemistry, Lafayette, Ind.

ON THE PROPERTIES OF TRIMETHYL SILYL AZIDE, by J. W. Connolly and G. Urry. [1962] [2]p. incl. tables. (AFOSR-J13) (AF 49(638)927) AD 444133 Unclassified

Also published in Inorg. Chem., v. 1: 718-719, Aug. 1962.

The melting point, vapor pressures, and infrared absorption spectra of Me_3SiN_3 prepared by treating Me_3SiCl with NaN_3 in the presence of aluminum azide in tetrahydrofuran solvent are reported.

2556

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

CRYSTALLINE LITHIOMETHYLTRIMETHYLSILANE AND SOME OF ITS PROPERTIES, by J. W. Connolly and G. Urry [1962] [2]p. (AF 49(638)927) Unclassified

Published in Inorg. Chem., v. 2: 645-646, June 1963.

The reaction of Li and chloromethyltrimethylsilane in 2-methylpentane gives $LiCH_2SiMe_3$ (I) in about 60% yield. Pure crystalline I is obtained by sublimation at 100°/10^{-5} mm, mp 112°. The liquid is stable to 130°, above that if decomposes slowly into tetramethylsilane (II) and a nonvolatile stable pyrophoric white solid. I reacts with MeOH to give equimolar quantities of pure II. Molecular weight of 92 was found by isopiestic method. I in benzene solution exhibits nuclear magnetic resonance of 2 proton resonances in a ratio of 4.5 to 1 with an internal shift of -2.16 ppm from Me to CH_2 protons. I reacts readily with chloromethyltrimethylsilane to form mainly 2,2,5,5-tetramethyl-2,5-disilahexane (III) and II with some 2,2,4,4-tetramethyl-2,4-disilahexane and less volatile products. I, treated with $CoCl_2$ yields II and III as the only products.

2557

Purdue U. [Dept. of Electrical Engineering] Lafayette, Ind.

ADAPTIVE LEARNING SYSTEMS, by J. E. Gibson. [1962] [5]p. incl. diagrs. (AFOSR-3789) (AF AFOSR-62-351) AD 292796 Unclassified

Presented at Nat'l. Electronics Conf., Chicago, Ill., Oct. 8-10, 1962.

Also published in Proc. Nat'l. Electronics Conf., v. 18: 795-799, 1962.

A learning system is defined as a generalization of an

adaptive control system. Basic learning system functions, such as pattern recognition and the training sequence, are discussed. Two proposed learning systems are described and some results are given to demonstrate the theoretical advantage of a system with learning. Studies are incomplete at this time and the concepts presented should be considered as an informal introduction to one point of view on learning systems. (Contractor's abstract)

2558

[Purdue U. Dept. of Physics, Lafayette, Ind.]

STUDY OF NUCLEAR STRUCTURE AND INTERACTIONS, by S. Gartenhaus. Final technical rept. Nov. 1, 1960-Jan. 31, 1962, 2p. (AFOSR-2562) (AF 49-(638)767) Unclassified

Various aspects of nuclear structure and interactions were studied. Among the topics discussed were: Proton-proton interaction; On a variational principle for a classical plasma; and S-wave pion-nucleon scattering.

2559

Purdue U. Dept. of Physics, Lafayette, Ind.

HIGH-ENERGY BEHAVIOR OF ELASTIC-SCATTERING AMPLITUDES, by M. Sugawara and A. Tubis. [1962] [4]p. incl. refs. (AFOSR-J1251) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-132, Atomic Energy Commission and National Science Foundation) AD 424321 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 355-358, Oct. 15, 1962.

Some properties of a high-energy scattering amplitude near the forward direction are derived, assuming the Mandelstam representation and a pure imaginary forward amplitude at infinite energy. Under certain conditions the asymptotic form resembles that resulting from a Regge pole.

2560

Purdue U. [Dept. of Physics] Lafayette, Ind.

IMPULSE APPROXIMATION CALCULATION OF HIGH-ENERGY DEUTERON-DEUTERON ELASTIC SCATTERING, by A. Tubis and B. Chern. [1962] [5]p. incl. diagrs. refs. (AFOSR-J1252) [AF AFOSR-62-132] AD 424318 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 358, Apr. 23, 1962.

Also published in Phys. Rev., v. 128: 1352-1356, Nov. 1, 1962.

The high-energy deuteron-deuteron elastic scattering cross section and vector polarization was calculated on the basis of the impulse approximation with the neglect of off-energy-shell effects in the nucleon-nucleon scattering matrix and effects of multiple scattering. The results are in terms of the free nucleon-nucleon scattering amplitudes and an appropriate Fourier transform of the deuteron wave function. For simplicity, the D-state component of the deuteron was neglected throughout this calculation. Numerical results are given for 312 and 620 mev. At the 2 energies considered, the results for the cross section are comparable to those for nucleon-deuteron scattering. The validity of the approximations used and possible improvements of the calculation are discussed. (Contractor's abstract)

2561

Purdue U. [Dept. of Physics] Lafayette, Ind.

ISOTOPIC SPIN IN $K \to 3\pi$, by G. Barton, C. Kacser, and S. P. Rosen. [1962] [4]p. (AFOSR-J1611) [AF AFOSR-62-132] AD 427620 Unclassified

Also published in Phys. Rev., v. 130: 783-786, Apr. 15, 1963.

Because recent data on $K_2^0 \to \pi^+\pi^-\pi^0$ are at variance with the $\Delta T = 1/2$ rule while the data on $K^+ \to 3\pi$ are not, the charge space kinematics of $K \to 3\pi$ are re-examined. Matrix elements are assumed to be at most linearly dependent on the usual variables S_i, and it follows that only 4 of the 7 possible 3π states can contribute to the decay. Of these states, 2 have $T = 1$, the third has $T = 2$ and the fourth $T = 3$. The possible values of ΔT are 1/2, 3/2, 5/2, 7/2, and accordingly, the most general interaction Hamiltonian is written as the sum of 4 parts $H_{n/2}$, each corresponding to $\Delta T = n/2$ ($n = 1, 3, 5, 7$). It is then possible to express the matrix elements, rates and spectra of all the modes of $K \to 3\pi$ in terms of the reduced matrix elements of $H_{n/2}$ between the four 3π states and the K meson. The analysis reveals that, provided the branching ratio of $K_2^0 \to 3\pi^0$ to $K_2^0 \to \pi^+\pi^-\pi^0$ is 3/2, the present data are consistent with an interaction Hamiltonian containing only $\Delta T = 1/2$ and 3/2, and a 3π final state of isotopic spin one.

2562

Purdue U. Jet Propulsion Center, Lafayette, Ind.

STABILITY CRITERIA FOR LONGITUDINAL PRESSURE OSCILLATIONS IN A ROCKET MOTOR, by S. N. B. Murthy, J. R. Osborn, and S. K. Srinath. [1962] [48]p. incl. diagrs. (AF AFOSR-62-360) Unclassified

By treating the rocket motor as a constant diameter duct with a finite width of combustion zone located between 2 uniform regions and with finite wave transmission coefficients at the nozzle and the injector ends, stability criteria are established for longitudinal pressure oscillations. It is shown that while the energy release rate per unit width of the combustion zone is critical in determining whether the motor will be stable, the location of the combustion zone in the motor, the overall length of the motor and the total amount of energy released influence the performance of the motor in a complex fashion. (Contractor's abstract)

2563

Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.

PLASMA ACCELERATION BY A 2 4 KMC GRADIENT ELECTRIC FIELD, by H. W. Hendel, D. D'Agostini and others. Sept. 12, 1962 [26]p. incl. diagrs. table. (Rept. no. [illegible]-1609) (AFOSR-4152) (AF 49(638)658) AD 285667 Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J. Nov. 28-Dec. 1, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 8: 175-176, Feb. 28, 1963.

Plasma velocities up to 2×10^6 cm/sec for Hg ions were measured for applied rf fields less than 200 v/cm at 140 and 330 mc and found to be in agreement with a theory developed on the basis of energy considerations. In recent work the applied frequency was raised to 2.4 kmc. Greater resolution of the velocity measurement was achieved by pulsing the accelerating rf field. The rf pulse time delay can be adjusted relative to the initiation of the plasma pulse to select a plasma volume element of critical density and thus accelerate to optimum velocity. The ion velocity was found to depend approximately linearly on the field strength. The plasma density in the 2.4 kmc experiments was higher than that of the previous experiments by a factor of about 100. The highest bulk ion velocity measured at 700 v/cm was 8×10^5 cm/sec. The new data, obtained at applied frequencies one order of magnitude higher than those previously employed and taken over a wider field strength range, are in good agreement with the theory when the functional dependence of the collision frequency upon plasma density and rf field strength is considered. In the range of the present experiments, the increase in collision frequency with increasing applied frequency reduces the gain in thrust expected from the use of a more dense plasma at a higher applied frequency. (Contractor's abstract)

Reaction Motors, Inc., Denville, N. J.
see Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

2564

Rensselaer Polytechnic Inst. [Dept. of Aeronautical Engineering] Troy, N. Y.

INSTABILITY OF A VORTEX SHEET IN NON-EQUILIBRIUM FLOWS, by K. C. Wang. [19 2] [6]p. incl. diagrs. refs. (AF 18(600)1591) Unclassified

Published in Phys. Fluids, v. 5: 1368-1373, Nov. 1962.

The stability of a plane vortex sheet between 2 uniform streams is examined with respect to small disturbances when the 2 media are relaxing diatomic gases (such as oxygen or nitrogen). For the equilibrium and frozen cases, the eigenvalue equation is identical in form with that of the conventional case, and the stability is decreased due to the relaxation. For the nonequilibrium case, the eigenvalue equation is complex and depends on the wavenumber of the disturbances; the vortex sheet is shown to be always unstable. (Contractor's abstract)

2565

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

LINEARIZED DISSOCIATING GAS FLOW PAST SLENDER BODIES, by T. Y. Li and K. C. Wang. Jan. 1962 [35]p. incl. refs. (Rept. no. TR-AE-6201) (AFOSR-2048) (AF 49(638)977) AD 274318 Unclassified

An inviscid, compressible, linearized dissociating gas flow over slender bodies of general cross section is considered. Essentially it is an extension of the conventional slender body theory including the dissociation effects. Both supersonic and subsonic cases are examined. To the present approximation the lateral forces and moments are found the same as those for the conventional case, but there exist additional nonequilibrium terms in the drag expression. If the body is pointed at both ends, the nonequilibrium term is formally the same for both the supersonic and the subsonic cases except that the sign in the respective cases is just the opposite. Physical aspects of the nonequilibrium drag problem are briefly considered. These considerations show that in the subsonic case the nonequilibrium term represents a drag and in the supersonic case it is a thrust. The supersonic drag of slender bodies of revolution at small angle of attack has been calculated, including dissociation effects. (Contractor's abstract)

2566

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

[STUDY OF HYPERSONIC FLOW PHENOMENA], by T. Y. Li. Final rept. Jan. 1962, 6p. incl. refs. (Rept. no. TR-AE-6203) (AFOSR-2049) (AF 49(638)977) AD 274782 Unclassified

The stability of a plane vortex sheet, between two uniform streams of dissociating gases, with respect to small disturbances is examined on the basis of a linearized theory. The effects of equilibrium dissociation are destabilizing to the vortex sheet flow. In a nonequilibrium flow, the vortex sheet is shown to be always unstable.

2567

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

SUPERSONIC DRAG OF SLENDER BODIES IN A SIMPLE DIATOMIC DISSOCIATING GAS, by Z. S. Chang. Jan. 1962, 25p. incl. diagrs. tables, refs. (Rept. no. TR-AE-6205) (AFOSR-2163) (AF 49(638)977) AD 274359 Unclassified

Quantitative results of linear slender-body theory are treated. The drag of 2 cases is considered; a circular cone and a parabolic spindle. The extra drag due to nonequilibrium effects turns out to be appreciable in 1 case. For the case of the circular cone, the extra drag is positive, while for the case of the parabolic spindle, the extra drag is negative indicating that the nonequilibrium effects decrease the total drag.

2568

Rensselaer Polytechnic Inst. [Dept. of Aeronautical Engineering] Troy, N. Y.

STEADY SUBSONIC DRAG IN NONEQUILIBRIUM FLOW OF A DISSOCIATING GAS, by T. Y. Li and K. Kusukawa. [1962] [17]p. incl. diagrs. refs. (AFOSR-3527) (AF 49(638)977) Unclassified

Also published in Proc. 1962 Heat Transfer and Fluid Mechanics Inst., Washington U. Seattle (June 13-15, 1962), ed. by F. E. Ehlers, J. J. Kauzlarich and others. Stanford U. Press, 1962, p. 109-125.

Adopting the Lagrange approach, the dynamic behavior of a thermodynamic system consisting of a moving material element along a streamline, subjected to the effects of dissociation and recombination, is examined. A linear equation governing the variations of pressure and specific volume along a streamline has been obtained. This equation can be treated generally and its solution is applied to the calculation of the drag on an arbitrary body in steady adiabatic dissociating gas flow. The results show that: (1) Chemical relaxation effects cause a phase difference to exist between the variations of pressure and specific volume. As a consequence of this phase difference the body will experience a positive nonequilibrium drag in subsonic dissociating gas flow. This nonequilibrium drag is shown to be of the second order in perturbation quantities; and (2) The effect of irreversible entropy increase along the streamline is to contribute to the above mentioned nonequilibrium subsonic drag a correction term which is of the third order in perturbation quantities. (Contractor's abstract)

2569

Rensselaer Polytechnic Inst. [Dept. of Aeronautical Engineering] Troy, N. Y.

STEADY SUBSONIC DRAG IN NONEQUILIBRIUM FLOW OF A DISSOCIATING GAS, by T. Y. Li and K. Kusukawa. [1962] [17]p. incl. diagrs. refs. (AFOSR-5062) (AF 49(638)977) AD 414139 Unclassified

Also published in Proc. 1962 Heat Transfer and Fluid Mechanics Inst., Washington U., Seattle (June 13-15, 1962), ed. by F. E. Ehlers, J. J. Kauzlarich and others. Stanford U. Press, 1962, p. 109-125.

For abstract see item no. 2568, Vol. VI.

2570

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

MERCURIC HALIDES AS MOLTEN ELECTROLYTES: PHYSICAL PROPERTIES, VIBRATIONAL SPECTRA, CONSTITUTION, AND ELECTRICAL CONDUCTANCE, by G. J. Janz and J. D. E. McIntyre. [1962] [8]p. incl. illus. diagrs. tables, refs. (AFOSR-3804) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)978 and National Science Foundation) Unclassified

Also published in Jour. Electrochem. Soc., v. 109: 842-849, Sept. 1962.

Densities, viscosities, electrical conductances, and Raman spectra for $HgCl_2$, $HgBr_2$, and HgI_2, are reported from the melting points to the boiling points. In contrast to ionic fused salts, the energies of activation for electrical conductance are greater than those for viscous flow. Evidence for autocomplex formation is discussed. A model for these molten electrolytes is advanced in which the primary constituents are simple molecules together with the complex ionic species HgX^+ and HgX_3^-. The entropy of fusion shown to arise, in large part, from an increase of rotational freedom rather than positional randomization, and the cohesive intermolecular forces are of the dispersion and multipole type rather than coulombic as in highly ionic melts. The mechanisms of transport processes for the solid and liquid states of these salts are discussed in the light of concepts current for molten electrolytes. (Contractor's abstract)

2571

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

MOLTEN NITRATES AS ELECTROLYTES: STRUCTURE AND PHYSICAL PROPERTIES, by G. J. Janz and D. W. James. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-3806) [AF 49(638)978] Unclassified

Also published in Electrochim. Acta, v. 7: 427-434, 1962.

The failure of theories used to explain properties of the alkali halides when applied to alkali nitrates is discussed. A disk-shaped model of the nitrate ion is

developed which has a radius of 2·3 A and thickness of 2·2 A. This model is used to discuss some of the properties of molten alkali nitrates. (Contractor's abstract)

2572

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

STRUCTURE AND PHYSICAL PROPERTIES OF MOLTEN SALTS, by G. J. Janz. Final rept. Dec. 1, 1960-Nov. 30, 1962, 6p. (AFOSR-4564) (AF 49(638)978) Unclassified

The properties and structures of molten nitrates and mercuric halides have been characterized; the former are examples of highly ionic systems and the latter are predominantly molecular molten salts. Studies of molten salt-mixtures using the preceding both as solutes and solvents are in progress. An interesting result is that a molecular salt such as $HgCl_2$ can be readily 'dissolved' in fused salt solvents, and, depending on the solute-solvent interactions thus induced, the $HgCl_2$ may suffer a complete loss of the triatomic linear molecular species (characteristic of the pure salt in its molten state) or, again, may dissolve molecularly. Other studies with such mixtures, and investigations of the Group II halides, in progress, are surveyed in this report.

2573

[Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.]

A MODIFIED INCREMENTAL STRAIN LAW FOR WORK-HARDENING MATERIALS, by W. H. Warner and G. H. Handelman. [1956] [15]p. (AFOSR-4980) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1586] and Wright Air Development Center) AD 416425 Unclassified

Also published in Quart. Jour. Mech. and Appl. Math., v. 9: 279-293, Sept. 1956.

A generalization of the incremental strain law given by Hodge, Prager, and Drucker is developed. The new law affords the possibility of several different types of loading regions in contrast to the single loading or unloading region of the older theories. The stress-strain relations can be explicitly inverted and minimum principles for the stress rates and strain rates proved in the manner of Greenberg. An absolute minimum principle corresponding to the differential equations of structural stability is developed. A particular evaluation of the coefficients indicates that the new law may have broader applications than the previous theory. (Contractor's abstract)

2574

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

ON THE EFFECTS OF THE ADDITION OF MASS TO VIBRATING SYSTEMS, by G. [H.] Handelman and H. Cohen. [1956] [10]p. (AFOSR-J479) (AF 18(600)1586) AD 407245 Unclassified

Also published in Proc. Ninth Internat'l. Cong. Appl. Mech., Brussels (Belgium) (Sept. 5-13, 1956), v. 7: 509-518, 1957.

For abstract see item no. RPI. 07:001, Vol. I.

2575

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

CONTINUOUS FORCING OF AN ON-OFF CONTROL SYSTEM, by B. A. Fleishman. Final rept. Nov. 1, 1958-Oct. 31, 1962, 3p. (AFOSR-4680) (AF 49(638) 514) AD 408382 Unclassified

The objective of this research project was to conduct analytical investigations of nonlinear systems in the areas of automatic control and mechanics. Principal concern was with the study of ordinary differential equations of the piece-wise-linear type (such as govern relay or on-off control systems) in the presence of time-dependent excitations or input signals. A second phase of the work was a study of a class of nonlinear wave equations.

2576

Rensselaer Polytechnic Inst. [Dept. of Mathematics] Troy, N. Y.

PERIODIC RESPONSE AND SUPERPOSITION IN AN ON-OFF CONTROL SYSTEM, by B. A. Fleishman. [1962] [10]p. (AFOSR-1257; (AF 49(638)514) AD 400840 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 5: 306-315, Oct. 1962.

For abstract see item no. 2348, Vol. IV.

2577

Rensselaer Polytechnic Inst. [Dept. of Mathematic] Troy, N. Y.

RANDOM VIBRATION OF ELASTIC STRINGS AND BARS, by W. E. Boyce. Jan. 11, 1962 [33]p. incl. diagrs. (Math. Rept. no. 49) (AFOSR-1908) (AF 49(638)962) AD 272037 Unclassified

This analysis considers the free transverse vibrations of elastic strings of random density per unit length, and the free longitudinal vibrations of elastic rods of random cross-section area. Mathematically, it is necessary to consider second order Sturm-Liouville eigenvalue problems having one or more random coefficients. Variational, asymptotic, and perturbation methods are employed to study the statistical relation between the eigenvalues and the random material properties of the string or bar.

2578

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

ELASTIC STABILITY OF BARS OF ARBITRARY LENGTH, by F. F. Ling and G. H. Handelman. Mar. 22, 1962 [20]p. incl. diagrs. table, refs. (Math. rept. no. 53) (AFOSR-2264) (AF 49(638)962) AD 274753 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: 685-689, 1962.

The linearized, elastic stability theory of Biezeno and Hencky for problems which are nonlinear both physically and geometrically is applied to 2 cases. An exact, plane strain solution, in closed form, is obtained for rectangular bars under uni-axial initial stress. Also obtained is an exact solution for round bars under uni-axial initial stress. Results show that the theory yields plausible information for bars of arbitrary length, i. e. included are short bars whose stability behavior have eluded description by classical theories. (Contractor's abstract)

2579

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

SMALL VIBRATIONS OF A SLIGHTLY STIFF PENDULUM, by G. H. Handelman and J. B. Keller. Mar. 1962, 19p. incl. diagrs. (Math. rept. no. 54) (AFOSR-2385) (In cooperation with New York U., N. Y.) (AF 49(638)962) AD 275934 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: 195-202, 1962.

The small vibrations of a vertical pendulum consisting of a bob suspended from a wire are studied. The wire is assumed to be clamped at its upper end. This pendulum has an infinite number of vibration frequencies. These frequencies are determined when the stiffness of the wire is small. The frequencies are found to reduce to those of a flexible pendulum when the stiffness is zero, and these frequencies are evaluated. The expansion of the frequencies is also determined for arbitrary stiffness of the wire when its mass is small compared to that of the bob. Numerical results based upon the present analysis are given. (Contractor's abstract)

2580

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

ANALYSIS OF THE DYNAMICS OF ELASTIC SYSTEMS. Final rept. Nov. 1, 1960-Oct. 31, 1962, 4p. (AFOSR-4555) (AF 49(638)962) AD 401179 Unclassified

The application of asymptotic methods to problems of elastic vibration and wave motion and the analysis of stochastic effects in the behavior of elastic structures was investigated. Two problems in elastic vibrations have been solved. One is concerned with the vibrations of a pendulum in which the elastic properties of the support rod are taken into account. The method of solution was based on an asymptotic expansion in terms of the small stiffness of the rod. Similarly, the transverse vibrations of a circular plate under tension were studied. The elastic stability of bars in which the cross-sectional dimensions are not small when compared with the length was analyzed. In the area of random effects, an analysis of the bending of columns by axial loads of random eccentricity was completed. The transverse vibrations of a taut string with randomly varying mass distribution were investigated. A somewhat similar problem concerning the longitudinal vibrations of an elastic bar whose cross-sectional area varies in a random manner was solved.

2581

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

VIBRATIONS OF A RECTANGULAR PLATE WITH DISTRIBUTED ADDED MASS, by H. Cohen and G. [H]. Handelman. [1956] [11]p. incl. diagrs. (AFOSR-4675) [AF 49(638)962] AD 407865 Unclassified

Also published in Jour. Franklin Inst., v. 261: 319-329, Mar. 1956.

The problem studied is that of determining the lowest frequency of vibration of a rectangular plate, simply supported on 2 edges and free on the other two, and carrying a rigid mass of finite width running completely across the plate. Appropriate minimum principles are developed and approximate frequencies computed. The frequency may be either less or greater than that of the unloaded plate depending on the ratio of the physical parameters.

2582

Rensselaer Polytechnic Inst. [Dept. of Mathematics] Troy, N. Y.

THE BENDING OF COLUMNS UNDER AXIAL LOADS OF RANDOM ECCENTRICITY, by W. E. Boyce. [1961] [10]p. incl. diagrs. table. (AFOSR-J387) (AF 49(638)962) Unclassified

Also published in Developments in Mechanics; Proc. Seventh Midwestern Mechanics Conf., Michigan State U., East Lansing (Sept. 6-8, 1961), New York, Plenum Press, v. 1: 143-152, 1961.

For abstract see item no. 2495, Vol. V.

2583

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

SPECTROSCOPIC STUDIES OF IMPLODING PLASMA RINGS IN DETONABLE GAS MIXTURES, by K. M. Foreman and M. E. Levy. July 30, 1962, [29]p. incl. illus. diagrs. (Rept. no. PPL-TR-62-16(865) (AFOSR-3973) (AF 49(638)552) AD 288098 Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 8: 167, Feb. 28, 1962. (Title varies)

Spectroscopic observations were made of the flow field behind a cylindrical hypersonic wave front resulting from an imploding electrical discharge into an initially low pressure quiescent gas. Sub-μsec resolved spectra were obtained by use of a quartz prism monochromator-photo-multiplier detector system with photographic recording of an oscilloscope displayed output signal. Electrically produced plasma rings were established in detonable as well as non-reactive gases. Strong indications were observed that exothermic reactions, as evidenced by H_2O emission, proceed in H_2 + 1, 2 O_2 reactant mixtures within less than 1 μ sec under certain initial low pressure conditions. A reaction threshold at 1 mm Hg A pressure was found for the particular reaction vessel used. Time-integrated spectrometer photos support the conclusions reached with the transient spectra analysis equipment.

2584

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

DEVELOPMENT OF SPACE- CHARGE DOMINATED DISCHARGES BETWEEN ELECTRODES, by P. M. Mostov and L. Aronowitz. Sept. 4, 1962 [23]p. incl. diagrs. table. (Rept. no. PPL-TR-62-23; RAC 1022A) (AFOSR-5045) (AF 49(638)552) AD 415449 Unclassified

Previous solutions for the transient development of the Townsend-type gaseous discharge between parallel electrodes have been limited to the uniform electric field low-current regime. The present study traces the growth into the highly non-linear space-charge dominated high-current regimes indigenous to many modern applications. The discharge is treated by a modified 3 fluid macroscopic formulation, with provisions for ionization and charge mobility in the gas proper, and the release of electrons at the cathode by incident positive ions. Gauss' law is used to account for space charge as it develops, rather than for an a posteriori correction. The important effect of field-distortion on Townsend's first coefficient and on electron and ion drift velocities is included. A versatile digital computer program applied to a low-pressure discharge has yielded a detailed examination of regimes usually grossly classified by the terms "formative time lag" and "breakdown." Very strong spatial and temporal variations of the electronic and ionic components of charge density, current and conductivity are found. (Contractor's abstract in part)

2585

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

GROWTH OF NONLINEAR TRANSIENT TOWNSEND DISCHARGES INCLUDING ELECTRODE AND SPACE-CHARGE EFFECTS (Abstract), by P. M. Mostov and L. Aronowitz. [1962] [1]p. [AF 49(638)552] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 460, Aug. 27, 1962.

Previous solutions for the growth of current and charge density in the transient Townsend discharge between parallel electrodes have been limited to linear low-current cases. The present study probes into the nonlinear high space-charge high-current regimes indigenous to many modern applications. A versatile digital program that includes the important effect of space-charge field distortion on Townsend's first coefficient and on the electron and ion drift velocities has been developed and used to provide a detailed examination of regimes usually grossly classified by "formative time lag" and "breakdown." Five distinct regimes of current growth and the mechanisms dominant in each, are identified and discussed. Transient characteristics of electrode and electrodeless discharges are compared. The program is sufficiently flexible to accept arbitrary voltage shapes, including the step voltages to which most previous analyses are restricted. Assumptions and regimes limitations are discussed. Spatial and temporal variations of the electronic and ionic components of charge

density, current, and conductivity for 4 voltages for argon at 10 mm, 1-cm gap, are given.

2586

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

PREREQUISITE FOR SHEATH SYMMETRY IN PULSED PLASMA ACCELERATORS (Abstract), by L. Arnowitz. [1962] [1]p. [AF 49(638)552] Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 177, Feb. 28, 1963.

Pulsed-plasma accelerators typically operate by connecting a capacitor bank charged to voltage V across axially symmetric electrodes between which is un-ionized low-pressure gas. The resulting discharge forms a more or less thin high-current "sheath" with maximum current density $j \geq 10^7$ A/m^2. For small values of V, the sheath may form asymmetrically or discontinuously on the electrode surfaces. An explanation for the loss of symmetry is suggested by the observation that the processes responsible for current growth during initial breakdown cannot account for the large sheath-current densities. It has been observed that an abrupt transition in the discharge mechanism may occur when the initial current exceeds a certain value for a sufficiently long interval. Since the sheath tends to form in the areas where the transitions first occur, it will be symmetric only when the value of dj/dt before the transition is large enough to confine the current to a thin symmetric region. It is shown that sheath symmetry in a linear pinch requires $dj/dt \sim 10^{12}$ A/m^2-sec, and that such large values are possible for sufficiently high V.

2587

Research Triangle Inst., Durham, N. C.

THE CONDITIONAL DISTRIBUTION OF SETS OF TESTS ON A SYSTEM SIMULATED FROM TESTS ON ITS COMPONENTS, by W. S. Connor. [1962] [3]p. (AFOSR-3238) [AF AFOSR-62-309] AD 611932 Unclassified

Also published in Ann. Math. Stat., v. 34: 1585-1587, Dec. 1963.

A description is given of a system which is made up of components in such a way that failure of any component causes the failure of the system, and the system cannot fail unless some component fails. There are n_i trails for component i, i = 1, ... , k, of which n_{i1} are successes and the rest are failure. Let $n^* = \min_i n_i$, $n_1^* = \min_i n_{i1}$. A trial for the system is simulated by drawing at random a result for each component. If all component results are successes, the system trial is a success. If not, the system trial is a failure. The process is continued, without replacement of component results, until n^* system trials have been generated. The principal purpose of this note is to derive the conditional distribution of S, the number of successful system trials, $0 \leq S \leq n_1^*$, given $n_{11}, \ldots, n_{k1}$. It is also shown that the conditional expectation of S, E(S), is the product of the estimated component reliabilities.

2588

RIAS, Inc., Baltimore, Md.

STABILITY AND CONTROL, by J. P. LaSalle. [1962] [13]p. incl. refs. (AFOSR-1936) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Army Ballistic Missile Agency) Unclassified

Also published in Jour. Siam Control, v. 1A: 3-15, 1962.

This is a brief survey, within the frame of control theory, of some of the basic notions and principal results of Liapunov's stability method, which is introduced here by way of the general stability problem for feedback control systems. For most of the technical details the reader is referred to a bibliography of 30 items which includes among some of the classical references a great number of the most recent significant contributions in this area. (Math. Rev. abstract)

2589

RIAS, Inc. Baltimore, Md.

COMPLETE STABILITY OF A NONLINEAR CONTROL SYSTEM, by J. P. LaSalle. [1962] [4]p. (AFOSR-2228) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Dept. of the Army) AD 451547 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 600-603, Apr. 1962.

This paper eliminates a restriction and simplifies the derivation of the complete stability of a nonlinear control system given in a previous paper (see LaSalle and Lefschetz, Stability by Lyapunov's Detect Method, with Applications, Academic Press, New York, 1961). More precisely, the control system is given by $\dot{x} = Ax - bf(\sigma)$, $\sigma = c'x - rf(\sigma)$. Introduce the Lyapunov function $V = x'(Bx + \int_0^\sigma f(s)ds$. It is shown that if f in continuous, and $\sigma f(\sigma) > 0$ for $\sigma \neq 0$, if B is positive and if $\dot{V}$ is negative definite, then the zero state $(x = 0, \sigma = 0)$ is completely stable (i. e., asymptotically stable in the large). (Math. Rev. abstract)

2590

RIAS, Inc., Baltimore, Md.

STABILITY AND LIMIT SETS, by T. Ura. Feb. 1962 [28]p. incl. diagrs. (Technical rept. no. 62-4) (AFOSR-2281) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Army Ballistic Missile Agency) Unclassified

In his book, The methods of A. Liapunov and their application, Moscow, 1957, Zubov states: A necessary and sufficient condition for the stability of a closed invariant set M is that no path from outside M possess an α-limit point in M. Here it is assumed that the dynamical system is defined on a complete separable metric space X, and that M possesses a relatively compact neighborhood U; by stability is meant that of Liapunov in the positive sense. It is known that Zubov's condition is merely necessary and not sufficient. On the other hand, it is known that in the case of a planar dynamical system, this condition is sufficient if M consists of a single isolated singular point. The object of this paper is to give some concrete counter-examples for Zubov's proposition and to obtain more general sufficient conditions, not merely for a singular point in the plane, but also for any compact invariant set in a general space.

2591

RIAS, Inc., Baltimore, Md.

SOME MATHEMATICAL CONSIDERATIONS ON NONLINEAR AUTOMATIC CONTROLS, by S. Lefschetz. [1960] 52p. incl. refs. (Technical rept. no. 62-10) (AFOSR-2501) (In cooperation with National U. of Mexico) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Army Ballistic Missle Agency) AD 608403 Unclassified

Also published in Contrib. Differential Equations, v. 1: 1-28, 1963.

The system of differential equations is $\dot{y} = Ay + \varphi(\sigma)b$, $\sigma = c' y - p\varphi(\sigma)$, where A is an n x n matrix, y, c and b are n-vectors, σ, p and $\varphi(\sigma)$ are scalars. The "admissible" scalar functions φ are continuous and $\sigma\varphi(\sigma) > 0$ for $\sigma \neq 0$. The problem is to find conditions under which the origin ($x = 0$, $\sigma = 0$) is asymptotically stable in the large for all admissible $\varphi(\sigma)$. This is called absolute stability. Assume that all the characteristic roots of A have negative real parts and let C be any positive definite n x n matrix. There is then a unique matrix B satisfying $A' B + BA = -C$ (the prime denotes transpose). Define $d = Bb + 1/2\, c$. It is then shown that the inequality $\rho > d'C^{-1} d$ is a sufficient condition for absolute stability. The significance of this condition is examined in detail when A is diagonal, and the relation to Aizerman's problem is mentioned. How the general method can be used to investigate more complex control systems is illustrated, special cases $n = 1$, 2 are studied, and one critical case is investigated.

2592

RIAS, Inc., Baltimore, Md.

ASYMPTOTIC STABILITY CRITERIA, by J. P. LaSalle. [1962] [9]p. incl. diagr. refs. (AFOSR-3371) (AF 49(638)382) AD 451546 Unclassified

Also published in Proc. Symposia in Appl. Math., v. 13: 299-307, 1962.

Previous results concerning applications and some extensions of Lyapunov's direct method (see item nos. 2361 and 2362, Vol. IV) are extended to periodic systems. A result on the ultimate behavior of solutions is also given. (Math. Rev. abstract, modified)

2593

RIAS, Inc., Baltimore, Md.

CONTROL OF RANDOMLY VARYING LINEAR DYNAMICAL SYSTEMS, by R. E. Kalman. [1962] [12]p. incl. refs. (AFOSR-3600) (AF 49(638)382) Unclassified

Also published in Proc. Symposia in Appl. Math., v. 13: 287-298, 1962.

Control of linear dynamical systems described in discrete time, whose equations of motion are independent random functions, is described. In particular, the stability of discrete time regulators whose equations of motion change in time in an independent random fashion is considered. Defining a suitable index of performance for the system, the author derives the control law of the system. Using this optimum control law it is shown that there exists a lower limit, $|L_i| > 1/\rho_{max}$, which the characteristic roots of the equations of motion, taken in the mean square sense, must satisfy for any control. If ρ_{max} is greater than or equal to unity, it is not possible to stabilize the system by any kind of control.

This result should be contrasted with that for deterministic systems, which can be stabilized to any degree desired, provided only that the control variables are not a priori bounded. (Math. Rev. abstract)

2594

RIAS, Inc., Baltimore, Md.

PERIODIC FUNCTIONS GENERATED AS SOLUTIONS OF NONLINEAR DIFFERENTIAL-DIFFERENCE EQUATIONS, by G. S. Jones. [1961] [8]p. incl. diagrs. refs. (AFOSR-4483) (AF 49(638)362) AD 406642 Unclassified

Also published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 105-112.

For abstract see item no. 2529 Vol. V.

2595

RIAS, Inc., Baltimore, Md.

THE CRITICAL CASE IN DIFFERENTIAL EQUATIONS, by S. Lefschetz. [1961] [14]p. (AFOSR-5194) [AF 49(638)382] Unclassified

Also published in Bol. Soc. Mat. Mexicana, v. 6: 5-18, 1961.

The following system is studied: (1) $\dot{y} = Y(y, z)$, $\dot{z} = Az + Z(y, z)$, where y is a p-vector, z a q-vector, A is a constant matrix, all of whose eigenvalues have negative real part, and Y, Z are power series convergent near y = 0, z = 0, which begin with terms of at least second degree and are such that y = 0, z = 0 is an isolated zero for them. Such a system may be considered as a canonical form for an n-vector equation $\dot{x} = Kx + X(x)$, where K has p eigenvalues equal to zero with simple elementary divisors and X is a power series with no constant and linear terms. By constructing a finite number of transformations which are regular near y = 0, z = 0, (1) is reduced to the system

(2) $\dot{y} = G(y, z) + \gamma 0(z) + \Sigma 1^{N-1} \nu k (Y, z)$, $\dot{z} = Az + Z^{*}(Y, z)$, with the following properties.

G(y, 0) is a power series whose terms g(y) of lowest degree N > 1 are such that (I) if y = 0 is asymptotically stable for $\dot{y}$ g(y) (which is the case if and only if N is odd), then y = 0, z = 0 is asymptotically stable for (2) and (1); (II) if N is even and if there is a p-vector ν for which $\gamma \cdot g(y)$ is positive definite, then y = 0, z = 0 is unstable for (2) and (1). The proofs of (I), (II) are based on considerations of appropriate Lyapunov functions. The cases p = 1, 2, 3 are examined separately. Two appendices on Lyapunov's stability theorems and on a special case of a theorem of Zubov make the paper self-contained. (Math. Rev. abstract)

2596

RIAS, Inc., Baltimore, Md.

ON THE STABILITY OF TIME-VARYING LINEAR SYSTEMS, by R. E. Kalman. [1962] [3]p. incl. table. (AFOSR-J260) (Sponsored jointly by Aeronautical Systems Division, AFOSR under AF 49 (638)382, and Army Ballistic Missile Agency) AD 400889 Unclassified

Also published in IRE. Trans. on Circuit Theory, v. CT-9: 420-422, 1962.

In 1946 James and Weiss introduced the following concept of stability: Definition 1: A (linear, constant-coefficient) system is stable if and only if every bounded input produces a bounded output. This definition has become very popular because it seems to make sense also for more general types of systems. Let $w(t, \tau)$ be the impulse response of a linear system, i. e., the effect at time t of a unit impulse applied at time τ. In 1951 Zadeh showed that the preceding definition can be related to the impulse response by: Theorem 1: A linear (constant or time-varying) system is stable in the sense of Definition 1 if and only if

$$\int_{-\infty}^{\tau} | w(\tau, \tau) | d\tau < \infty \text{ for all } \tau.$$

The present note presents 3 counterexamples to show that Definition 1 is not wholly satisfactory, and that it is not possible to determine the stability of a time-varying linear system from its impulse response, without supplementary assumptions concerning the system itself.

2597

RIAS, Inc , Baltimore, Md.

A CLASS OF FUNCTIONAL-DIFFERENTIAL EQUATIONS, by J. K. Hale. [1962] [13]p. (AFOSR-J1217) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Army Ballistic Missile Agency) AD 423626 Unclassified

Also published in Contrib. Differential Equations, v. 1: 411-423, 1963.

The behavior of the solutions of a particular class of functional-differential equations is discussed as the independent variable approaches infinity. This class of equations arises as a natural generalization of the class of ordinary differential equations considered in an earlier paper, Behavior of Solutions Near Integral Manifolds, which in turn, has many interesting applications to the behavior of solutions of ordinary differential equations near integral manifolds. This analysis generalizes most of the results of the earlier paper to functional-differential equations. A Lyapunov functional is used.

2598

RIAS, Inc., Baltimore, Md.

FUNCTIONAL-DIFFERENTIAL EQUATIONS WITH PARAMETERS, by J. X. Hale. [1962] [10]p. (AFOSR-J1218) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382, Army Ballistic Missile Agency, and Office of Naval Research) AD 424711 Unclassified

Also published in Contrib. Differential Equations, v. 1: 401-410, 1963.

Previous results of the author (see item no. 2518, Vol. V) are extended to a more general type of equations. Results are summarized which are obtainable for a simple ordinary differential system (1) dy/dt = A(x)y

where t is a scalar, x is an m-vector, y is an n-vector, and A(x) is an n x n matrix whose elements are continuously differentiable with respect to x for x in some set U. For a given $t_0 \geq 0$ and a given x in U, it is supposed that there exist functions $\beta(x)$, K(x) continuous in x for x in U. $\beta(x)$ [not necessarily of constant sign] possessing a continuous first derivative respect to x such that the solution $y(t, t_0, x, y_0)$, $y(t_0, t_0, x, y_0) = y_0$ of (1) satisfies the relation (2)

$$\| y(t, t_0, x, y_0) \| \leq K(x) e^{-\beta(x)(t - t_0)} \| y_0 \|, \quad t \geq t_0.$$

The basic lemma states the existence of a function V(t, x, y) (similar to a Lyapunov function) associated with the class of functions (2) satisfying (1). It is shown that V(t, x, y) is a Lipschitzian in x, y and the Lipschitz constants are given in terms of $\beta(x)$, K(x) and the derivative of the matrix A(x) with respect to x.

2599

RIAS, Inc., Baltimore, Md.

SYMMETRY ADAPTED FUNCTIONS BELONGING TO THE CRYSTALLOGRAPHIC GROUPS, by H. V. McIntosh. [1958] [24]p. incl. diagrs. refs. (AFOSR-J1513) (AF 49(638)382) AD 429254 Unclassified

Presented at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, 1958.

Also published in Jour. Molec. Spectros., v. 10: 51-74, Jan. 1963.

Various authors have discussed methods of obtaining the irreducible representations of groups containing nontrivial normal subgroups, in terms of the representations of the normal subgroup and its factor group. These results have applied to special cases, such as to normal subgroups of prime index or to the case in which a subgroup exists isomorphic to the factor group and having one element in each coset of the normal subgroup. These results have been extended to a general theory, which not only includes all the results of the papers cited, but also enables one to obtain very easily the characters and representations of certain classes of groups heretofore obtainable only by special methods. Examples of such groups are crystallographic double groups which have been discussed by Bethe, Elliott, and Opechowski as well as those crystallographic lattice groups for which there is no subgroup isomorphic to the corresponding point group. The basis of this theory is a canonical form for the representations of a semidirect product of 2 groups; a generalization of the representation theory of direct products which is developed in the present paper. (Contractor's abstract)

2600

RIAS, Inc., Baltimore, Md.

ON THE ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF A CLASS OF DIFFERENTIAL EQUATIONS, by J. K. Hale and N. Onuchic. [1962] [15]p. incl. diagr. (AFOSR-64-0356) (AF 49(638)382) AD 434502 Unclassified

Also published in Contrib. Differential Equations, v. 2: 61-75, 1963.

Consider the equation $w' = Aw + f(t, w)$ where w, f are n-vectors, A is an n x n matrix and f(t, w) is a continuous function of t, w for all $t \geq 0$ and w in some set U. Many papers have discussed the asymptotic relationships between the solutions of the above equation and the solutions of $w' = Aw$. However, in most of these papers, it is assumed that the function f(t, w) is either "small" for large values of t and all $w \in U$ or "small" compared with the matrix A. In this paper, consideration is given to some asymptotic relationships between the solutions of these 2 equations for cases when the function f(t, w) is not necessarily small for all w in some sets but becomes small along solutions of the equation.

2601

RIAS, Inc., Baltimore, Md.

STRUCTURAL STABILITY ON TWO-DIMENSIONAL MANIFOLDS, by M. M. Peixoto. [1961] [20]p. incl. diagrs. refs. [AF 49(638)382] Unclassified

Published in Topology, v. 1: 101-120, 1962

Let M^2 be a 2-dimensional compact differentiable manifold, and B the space of all vector fields on M^2.

A vector field X on M^2 is said to be structurally stable if given $\epsilon > 0$ there is a neighborhood Δ of X in B such that whenever $Y \in \Delta$ there is an ϵ-homeomorphism of M^2 onto itself transforming trajectories of X onto trajectories of Y. In order that the vector field X be structurally stable on M^2 it is necessary and sufficient that the following conditions be satisfied: (1) there is only a finite number of singularities, all generic; (2) the α and w-limit sets of every trajectory can only be singularities or closed orbits; (3) no trajectory connects saddle points; and (4) there is only a finite number of closed orbits, all simple.

2602

RIAS, Inc., Baltimore, Md.

ADAPTIVE FINITE TIME FILTERING, by R. S. Bucy and J. W. Follin, Jr. [1962] [10]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382, Bureau of Naval Weapons, and National Science Foundation) Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-7: 10-19, July 1962.

A detailed analysis of a particular adaptive filter has been carried out and the required extension of the theory to the general case is indicated. The filter

measures the spectral densities of the input signal and noise processes and adjusts its band-pass to give optimal filtering in the Wiener sense. The behavior is examined in the linear approximation and a crude treatment of the nonlinear transient response is given. These results compare favorably with an analog simulation. (Contractor's abstract)

2603

RIAS, Inc., Baltimore, Md.

GLOBAL GROSS SECTIONS OF COMPACT DYNAMICAL SYSTEMS, by S. Schwartzman. [1962] [6]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)382], Army Ballistic Missile Agency, and Office of Naval Research) Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 48: 786-791, May 1962.

Let (X, R, φ) be a transformation group with compact connected, locally connected, locally simply connected phase space X, and phase group the reals. A closed subset K of X is said to be transverse to the flow provided there exists $\epsilon > 0$ such that φ restricted to K x $(-\epsilon, \epsilon)$ is a homomorphism onto an open set. Two theorems are discussed. Theorem 1: The following conditions on a closed subset K of X are equivalent. (1) K is transverse to the flow and every orbit intersets K. (2) The natural map φ makes K x R into a regular covering of X with an infinite cyclic group of covering transformations. (3) The natural map is a local homeomorphism onto all of X. (4) There exists a function f (x) of absolute value one defined on X whose angular variable is strictly increasing along each orbit such that K is the set of points where f(x) is called a cross-section if it satisfies any of the conditions 1 through 4. Theorem 2: If K_1 and K_2 are 2 connected cross-sections of a given flow in X, the universal covering spaces of K_1 and K_2 are homeomorphic. The map f in (4) defines a one-dimensional cohomology class in X. It is shown that if K_1 and K_2 are 2 cross-sections having the same associated cohomology class, then they are naturally homeomorphic. (Math. Rev. abstract, modified)

2604

RIAS, Inc., Baltimore, Md.

LYAPUNOV FUNCTIONS FOR THE PROBLEM OF LUR'E IN AUTOMATIC CONTROL, by R. E. Kalman. [1962] [5]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638) 382 and National Aeronautics and Space Agency) Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 49: 201-205, Feb. 1963.

This paper is concerned with the global asymptotic stability of the class of closed loop control systems governed by the equations (1) $dx/dt = Fx - g\varphi(\sigma)$, $d\xi/dt = \sigma(\sigma)$, $\sigma = h'x + \rho\xi$, where σ, ξ, ρ are real scalars, x, g, h are real n-vectors, and F is a real, stable n x n matrix. $\varphi(\sigma)$ is a real-valued continuous function which belongs to the class A_k: $\varphi(0) = \sigma$, $0 < \sigma\varphi(\sigma) < \sigma^2 K$. Lur'e posed the problem of finding conditions on ρ, g, h and F which are necessary and sufficient for the existence of a Lyapunov function V of a special class (quadratic in x and σ plus the integral of $\varphi(\sigma)$ which insures global asymptotic ability of (1) for any φ in the class A_∞. Later Popov was able to show that if F is stable and $\rho > 0$, then global asymptotic stability of (1) is assured if $\mathrm{Re}(2\alpha\rho + i\omega\beta)[h'(i\omega I - F)^{-1}g + \rho/i\omega] \geq 0$, for all real ω, holds for $2\alpha\rho = 1$ and some $\beta \geq 0$ (P). Popov was unable to resolve the question of existence of a Lyapunov function which assures global asymptotic stability whenever (P) holds. Using the theory of controllability of linear dynamical systems, the question is completely settled and at the same time the problem posed by Lur'e is solved. (Math. Rev. abstract)

2605

RIAS, Inc., Baltimore, Md.

THE STATISTICAL MECHANICS OF MICELLES, by R. H. Aranow. [1962] [7]p. incl. refs. (AFOSR-J714) (AF 49(638)735) AD 415057 Unclassified

Also published in Jour. Phys. Chem., v. 67: 556-562, Mar. 1963.

A theory of micelle statistics is developed using the extended theory of dilute solutions, the dielectric continuum model of the solvent, and the statistical mechanical treatment of physical clusters at constant pressure. A connection is made between the mass action approach and the 2-phase approach currently in use for examining micelle behavior. Both ionic and nonionic micelles are treated. A discussion is given for non-ionic micelles of the meaning of averages, fluctuations in size, ideality, and variation of c. m. c. with temperature. A more general theory of micelle statistics is formulated by the elimination of the continuum model of the solvent and the extended theory of dilute solutions. Reich's model for non-ionic micelles is used to illustrate the theory. (Contractor's abstract)

2606

RIAS, Inc., Baltimore, Md.

EFFECT OF DIFFUSION ON INTERFACIAL TAYLOR INSTABILITY, by R. H. Aranow and L. Witten. [1962] [8]p. incl. tables, refs. (AFOSR-J894) (AF 49(638)735) Unclassified

Also published in Phys. Fluids, v. 6: 535-542, Apr. 1963.

A theory is developed concerning the onset of interfacial instabilities at the liquid-liquid interface between 2 solvents when they are mutually immiscible and when a third species, the solute, is diffusing across the interface. The analysis made involves solving the linearized hydrodynamic equations of motion for an idealized model with appropriate boundary conditions at the interface. The interface becomes unstable and turbulence at the interface develops under certain conditions which depend upon the densities of the solutions, the strength of the frictional forces between solute and solvents, concentration gradients, and the direction and rate of diffusion of the solute. The effects of surface tension and viscosity are considered. Some experimental results pertaining to the instability are cited. (Contractor's abstract)

2607

RIAS, Inc., Baltimore, Md.

THE LIGHT INDUCED ELECTRON PARAMAGNETIC RESONANCE SIGNAL OF PHOTOCATALYST P700, by H. Beinert, B. Kok, and G. Hoch. [1962] [4]p. (AFOSR-2293) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947, Atomic Energy Commission, and National Institute of Health) Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 7: 209-212, 1962.

One unit or mol of the photocatalyst P700 (I) pigment complex occurs for each 300-400 mol of chlorophyll (II) in all aerobic photosynthetic organisms. In whole cells or chloroplasts, I undergoes photochemical bleaching sensitized by surrounding II, which brings the pigment into the oxidized state and an associated moiety into the reduced state. A second photochemical conversion mediated by dark reactions regenerates I in a reduced state. Data are given on chemical and physical agents which produce oxidation and reduction of I. In experiments on red algae (strain TX 27) the I (which is a single electron-transferring agent) gave a weak Mn^{++} and a stronger Fe^{+++} signal, as well as a free-radical signal under some experimental conditions. Similar signals were obtained from scenedesmus.

2608

RIAS, Inc., Baltimore, Md.

LIGHT CONVERSION IN PHOTOSYNTHESIS, by B. Kok. [1962] [22]p. incl. diagrs. table. refs. (AFOSR-2632) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947, National Institutes of Health, and School of Aero-space Medicine) AD 415243 Unclassified

Also published in 6570th Biologistics for Space Systems Symposium, Aerospace Medical Research Lab., Wright-Patterson AFB, Ohio, Oct. 1962, p. 83-104.

This article is devoted to the basic phenomena behind the photosynthetic conversion of light into chemical energy. The main question considered is the manner in which the plant grasps and uses the tiny amount of energy found in photons of some 680mμ wave lengths. Since this article is a summary of present facts and speculations about phtosynthesis the following topics are discussed: energy carriers, ATP and $TPNH_2$; fluorescence, which is one of the ways a chlorophyll molecule can dispose of an absorbed photon by re-emitting a photon of red (680mμ) light (this is useful in proving light absorption by pigments); evidence for 2 photoreactions in photosynthesis as discovered by Emerson, who suggested that 2 pigments must be excited to perform efficient photosynthesis and thus indicated involvement of 2 light reactions, one synthesized by light absorption in chlorophyll a and one by another pigament (for example, chlorophyll b); and finally the question for the future, the distribution of light between the 2 photo steps and how optimal distribution is achieved, securing overall efficiency in the plant.

2609

RIAS, Inc., Baltimore, Md.

SENSITIZATION OF CHLOROPLAST REACTIONS. I. SENSITIZATION OF REDUCTION AND OXIDATION OF CYTOCHROME C BY CHLOROPLASTS, by B. Kok, G. Hoch, and B. Cooper. [1962] [2]p. incl. diagrs. refs. (AFOSR-3006) (AF 49(638)947) AD 412440 Unclassified

Also published in Plant Physiol., v. 36: 274-279, May 1963.

Normal photoreduction of cytochrome c by chloroplasts is changed to photooxidation by treatment with detergent, by aging, or by mild heating. During the transition from one action to the other, the long wave limit of photoreduction shifts to shorter wavelengths and either a net reduction or net oxidation can be observed - dependent on wavelength. The effectiveness spectrum of the photoreduction process shows a drop at wavelengths beyond 690 mμ. In contrast, the quantum yield of photooxidation rises at long wavelengths.

2610

RIAS, Inc., Baltimore, Md.

ON THE PIGMENT ABSORBING AT 750 mμ OCCURRING IN SOME BLUE-GREEN ALGAE, by E. B. Gassner. [1962] [3]p. incl. diagr. (AFOSR-3484) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947 and National Institutes of Health) Unclassified

Also published in Plant. Physiol., v. 37: 637-639, Sept. 1962.

A study was made of the pigment responsible for the

the absorption maximum at 750 mμ found in 2 strains of blue-green algae. In Synechococcus cedrorum (Sauvg.) the 750 mμ absorption band was relatively high, amounting to approx 1/20 the height of the chlorophyll peak. Procedures of extraction and partial purification have been developed. The long wavelength absorption maximum at 750 mμ in vivo shifts to about 730 mμ after the pigment is extracted into organic solvents. The complete spectrum of the purified pigment is complex and resembles that of bacterial pheophytin. Effects of light, pH, solvent and oxidation-reduction reagents on both the 750 mμ and 730 mμ forms of the pigment were examined. No indications for a possible biological activity were obtained.

2611

RIAS, Inc., Baltimore, Md.

THE LIGHT INDUCED EPR SIGNAL OF PHOTOCATALYST P700. II. TWO LIGHT EFFECTS, by B. Kok and H. Beinert. [1962] [6]p. incl. diagr. (AFOSR-J39) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947, Atomic Energy Commission and National Institutes of Health) AD 297148; AD 403550 Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 9: 349-354, Oct. 31, 1962.

EPR data support an earlier proposition that the species involved is the oxidized form of photoconverter P700 and a suggestion concerning the metabolic role of this intermediate.

2612

RIAS, Inc., Baltimore, Md.

PHOTOSYNTHESIS AND RESPIRATION, by G. Hoch, O. v. H. Owens, and B. Kok. [1962] [10]p. incl. diagrs. tables, refs. (AFOSR-J571) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947 and National Institutes of Health) AD 407386; AD 410135 Unclassified

Also published in Arch. Biochem. and Biophys., v. 101: 171-180, Apr. 1963.

The effect of light on oxygen uptake and production by algae was studied. Illumination was found to influence oxygen uptake by 2 mechanisms. Oxygen uptake was found to be inhibited at low light intensities and accelerated at medium to high intensities. The inhibition of uptake was mainly sensitized by chlorophyll a. The effects of starvation, glucose supplementation, and DCMU inhibition on the oxygen uptake rates in the light are described. (Contractor's abstract)

2613

RIAS, Inc., Baltimore, Md.

A MASS SPECTROMETER INLET SYSTEM FOR SAMPLING GASES DISSOLVED IN LIQUID PHASES, by G. Hoch and B. Kok. [1962] [11]p. incl. diagrs. table. (AFOSR-J572) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947 and National Institutes of Health) AD 411914; AD 412311 Unclassified

Also published in Arch. Biochem. and Biophys., v. 101: 160-170, Apr. 1963.

A mass spectrometer inlet system has been devised which permits continuous sampling of gases dissolved in liquid phases. The principle is that of a semipermeable membrane which allows the dissolved gases, but not the liquid phases, to enter the mass spectrometer. The instrument permits rapid time response and high sensitivity. The application of this system to the study of reaction kinetics is described. (Contractor's abstract)

2614

RIAS, Inc., Baltimore, Md.

ELECTRON TRANSPORT IN CHLOROPLAST REACTIONS, by B. Kok, B. Cooper, and L. Yang. [1962] [24]p. incl. diagrs. tables, refs. (AFOSR-J957) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947 and National Institutes of Health) AD 415839 Unclassified

Also published in Microalgae and Photosynthetic Bacteria, 1963, p. 373-396.

A study was made of the absorption changes induced by repetitive flashing light in chloroplast suspensions. The stepwise reduction of various substrates by the flashes was accompanied by a cyclic change of absorption (turnover) of "P700" and "P520". The indication was that only part of the pigment systems contributed to the absorption changes. An association with the "first" (long wave sensitized) photoact was indicated for both pigments. No absorption change was clearly correlated with the "second" photoact. A dissimilar response of P700 and P 520 was observed, in several cases, most notably in the presence of phenazine methosulfate. Pigment turnover in the absence of (net) substrate reduction, observed in several instances was considered to indicate a cyclic electron transport: Turnover induced by several substrates failed to stop after depletion of the oxidant and turnover induced by dichlorophenolindophenol (DCPIP) after addition of 3-(3, 4-dichlorophenyl)-1,1-dimethylurea (DCMU). The poison did not inhibit the reduction of the dye by the flashes but caused a complete re-oxidation during the dark periods. This accessibility of reduced indophenol to photo-oxidized P 700 underlies its restoring effect upon DCMU inhibited triphosphopyridine nucleotide (TPN) reduction and the associated pigment turnover.

The data appeared to indicate a mechanism of photosynthesis in which the photo-oxidant of the first photoact—P 700^{+} or an immediate conversion product—is subjected to the second photoact. Consequently the photoreductant of the first photoact was assigned a low enough potential to concurrently dirve adenosine triphosphate (ATP) formation and TPN reduction. (Contractor's abstract)

2615

RIAS, Inc., Baltimore, Md.

THE EMERSON ENHANCEMENT EFFECT IN TPN-PHOTOREDUCTION BY SPINACH CHLOROPLASTS, by R. Govindjee and G. Hoch. [1962] [4]p. incl. tables. (AFOSR-64-0080) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947, National Science Foundation and Public Health Service) AD 431171 Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 9: 222-225, Oct. 17, 1962.

The rate of the photoreduction of TPN by spinach chloroplasts was proportional to the intensity of light at a given wavelength. An increased Emerson effect (ratio of light action by far red light in presence of supplementary light to the light action of far red light in absence of supplementary light) occurred with increasing wavelength. These data indicate that the TPN-Hill reaction requires 2 photosynthetic steps.

2616

RIAS, Inc., Baltimore, Md.

INTERIOR FIELD AND POTENTIAL IN SPACE CHARGE LIMITED PHOTOCONDUCTIVITY, by [D. Kahn and D. E. Grabenstein]. [1962] [8]p. incl. illus. diagrs. table. [AF 49(638)1017] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 173, Mar. 26, 1962.

Measuremenis of the interior potential of an illuminated KBr crystal containing F centers under an applied dc potential have been made using a metallic probe connected to an electrometer. The results agree with the predictions of the theory for a crystal with 2 current-blocking electrodes. The contact potential between the crystals and the electrode can be determined by varying the applied dc potential. The interior potential is constant over most of the crystal. This agrees with measurements of the interior field of the crystal with a low-frequency (0.01-40 cps) ac voltage applied to the illuminated crystal. The field is determined by observing the current pulse caused by an additional, short light flash on the crystal. The initial height of the pulse is proportional to the field averaged over the illuminated portion of the crystal. At low frequencies, the pulse height during dc illumination is much lower than when the crystal is not illuminated, indicating a flattening of the interior field.

2617

RIAS, Inc., Baltimore, Md.

RECOMBINATION IN SPACE-CHARGE LIMITED PHOTOCONDUCTIVITY (Abstract), by D. E. Grabenstein and D. Kahn. [1962] [1]p. [AF 49(638)1017] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 172, Mar. 26, 1962.

The variation with illumination of the ac photoconductivity in illuminated KBr crystals with current-blocking electrodes has been studied. The variation of the low-frequency limit of photocapacitance and the high-frequency limit of the photoconductance with illumination for some specimens agrees with that expected on the assumption of bimolecular recombination. This is in agreement with the results of Onuki. Subsequent illumination of the crystals produced a gradual decrease in the variation with intensity, until little or no change could be observed by decreasing the illumination by a factor of 30. This latter behavior has been observed by Macdonald. The decrease in variation is ascribed to the bleaching of the crystals at the electrodes.

2618

RIAS, Inc., Baltimore, Md.

APPEARANCE AND IONIZATION POTENTIALS OF SELECTED FRAGMENTS FROM ISOTOPICALLY LABELED PENTABORANES, by J. J. Kaufman, W. S. Koski and others. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-J1482) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1220 and Office of Naval Research) AD 427538 Unclassified

Presented in part at Inorg. Chem. Div. of the 140th Nat'l. meeting of the Amer. Chem. Soc., Chicago, Ill., Sept. 1961.

Also published in Jour. Amer. Chem. Soc., v. 85: 136.-1375, May 20, 1963.

This paper presents appearance potentials of isotopically labeled pentaboranes, $B^{11}_{5}H_{9}$ and $B^{11}_{5}D_{9}$, and some of their fragment ions as determined by mass spectrometric electron impact measurements. A set of apparently self-consistent ionization potentials for the pentaboranes and various fragments was calculated from these appearance potentials using what little

thermochemical bond energy data are available combined with the authors' interpretation of the processes taking place on ionization and fragmentation. $A(B_5H_9) > A(B_5D_9)$ is compared to $A(B_2H_6) < A(B_2D_6)$ and possible reasons for the reversal of ionization potential differences are discussed. Using an IBM 7090 computer program, isotopic fragmentation patterns for normal and deuteriated pentaboranes were calculated from the mass spectra of these compounds at 70 ev. (Contractor's abstract)

2619

RIAS, Inc., Baltimore, Md.

THE EFFECT OF SUBSTITUTION OF THE IONIZATION POTENTIALS OF FREE RADICALS AND MOLECULES. II. THEORETICAL INTERPRETATION OF DELTA K VALUES FOR ALKYL RADICALS AND AMINES, by J. J. Kaufman. [1962] [5]p. incl. refs. (AFOSR-J1484) (AF 49(638)1220) AD 427535 Unclassified

Presented at Eighteenth Internat'l. Cong. of Pure and Applied Chemistry Symposium on Structure and Reactivity of Small Molecular Species, Montreal (Canada), Aug. 1961.

Also published in Jour. Amer. Chem. Soc., v. 85: 1576-1580, June 5, 1963.

The constancy of δ_K values [which measure the change in ionization potential between a substituted molecule (or radical) and the parent compound] for alkyl radicals and amines is discussed in terms of the energies and possible wave functions for these species and their corresponding positive ions. For an alkyl radical it is possible to separate the σ- and π-electrons, and, to a first approximation, deal with the wave function, Hamiltonian and orbital of only the π-electron. It is shown to be possible to describe the wave functions and Hamiltonians for the substituted and unsubstituted amines and their positive ions in a manner which emphasizes their close similarity to the alkyl radicals by making a formal separation into σ- and "π-like" electrons. The wave functions of the π- and "π-like" electrons are described and the effects of various perturbations on the Hamiltonians are shown. A comprehensive treatment of a pure inductive effect of a substituent group is given and the extension to substituent groups capable of mesomeric effects is indicated.

2620

Rice U. [Dept. of Mathematics] Houston, Tex.

ON THE CHARACTERISTIC, T(r), of e^{e^z}, by G. R. MacLane. July 1961, 8p. (AFOSR-326); [AF 49(638)205] Unclassified

Based on Cartan's formula: $T(r) = \frac{1}{2\pi}\int_0^{2\pi} N(r, e^{i\alpha})\, d\alpha + \log^+ |f(0)|$, an investigation is made of the question raised by W. K. Hayman: what is the Nevanlinna characteristic function for e^{e^z}? Proof is offered that for any given positive ϵ,

$$T(r) = \frac{r^{-1/2}\, e^r}{2^{1/2}\, \pi^{3/2}} \left(1 + O\left(r^{\epsilon - 1/2}\right)\right).$$

2621

Rice U. [Dept. of Mathematics] Houston, Tex.

ON THE RADIAL LIMITS OF BLASCHKE PRODUCTS, by G. R. MacLane and F. B. Ryan. [1961] [6]p. [AFOSR J623) (AF 49(638)205) AD 415060 Unclassified

Also published in Pacific Jour. Math., v. 12: 993-998, Fall 1962.

The object of the present paper is to give a partial answer to the question: how many times does f(z) assume a given radial limit? The following theorem is proven: Let E be a given closed set on $\{|w| = 1\}$ and let E' be the complement of E relative to $\{|w| = 1\}$. Then there exists a Blaschke product f(z), all of whose radial limits are of modulus one, and such that the set $L(\beta) = \{\theta \mid f(e^{i\theta}) = e^{i\beta}\}$ has the power of the continuum for $e^{i\beta} \in E$ and is countable for $e^{i\beta} \in E'$.

2622

Rice U. [Dept. of Mathematics] Houston, Tex.

THE GEOMETRY OF FUNCTIONS HOLOMORPHIC IN THE UNIT CIRCLE, OF ARBITRARILY SLOW GROWTH, WHICH TEND TO INFINITY ON A SEQUENCE OF CURVES APPROACHING THE CIRCUMFERENCE, by G. R. MacLane. [1962] [7]p. (AFOSR 64-1586) (AF 49(638)205) AD 446532 Unclassified

Also published in Duke Math. Jour., v. 29: 191-197, June 1962.

For abstract see item no. 2537, Vol. V.

2623

Rice U. Dept. of Mathematics, Houston, Tex.

THE DETERMINATION OF A COEFFICIENT IN A PARABOLIC DIFFERENTIAL EQUATION. PART II. NUMERICAL APPROXIMATION, by J. Douglas, Jr. and B. F. Jones, Jr. [1962] [8]p. (AFOSR-J446) (AF 49(638)632) AD 407115 Unclassified

This sequel to (item no. 2624 Vol. VI) is concerned with an effective means of computing the solution a(t). The authors show (using a modified iteration procedure), that given $\epsilon > 0$ and a fixed mesh width $k > 0$, it is possible to compute a polygonal function $\phi_k(t)$ on $[0, T_0]$, $T_0 < T$, with vertices at the points $k, 2k, \ldots, Nk = T_0$, which is bounded from above and below by appropriate functions of t, and which satisfies the inequality $|\phi_k(t) - L\phi_k(t)| < \epsilon$ for $t = k, 2k, \ldots, Nk$. Then, using the properties of L obtained in the previous article, they show that for small k, $\phi_k(t)$ is actually a good approximation to a(t) for all t in $[0, T_0]$. (Math. Rev. abstract)

2624

Rice U. Dept. of Mathematics, Houston, Tex.

THE DETERMINATION OF A COEFFICIENT IN A PARABOLIC DIFFERENTIAL EQUATION. PART I. EXISTENCE AND UNIQUENESS, by B. F. Jones, Jr. [1962] [12]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)632] and National Science Foundation) Unclassified

Published in Jour. Math. and Mech. v. 11: 907-918, Nov. 1962.

The following problem, corresponding to a heat conduction on a semi-infinite rod, with variable and unknown thermal conductivity is considered: to find u(x, t) and a positive a(t) satisfying

$$\begin{aligned} &\frac{\partial u}{\partial t} = a(t)\frac{\partial^2 u}{\partial x^2}, && 0 < x < \infty,\ 0 < t < T, \\ &u(x, 0) = 0, && 0 \le x < \infty, \\ &u(0, t) = f(t), && 0 \le t < T, \\ &-a(t)\frac{\partial u}{\partial x}(0, t) = g(t), && 0 < t < T. \end{aligned} \tag{1}$$

Here f(t) and g(t) are given, with $g > 0$, $f(0) = 0$, and $f'(t) > 0$ for $t > 0$. After the change of variables $\eta = \int_0^t a(\tau)\,d\tau$ is made, the coefficient a(t) disappears from the first of these equations. Thus, with the appropriate assumptions on the growth of $u(x, t)$ as $|x| \to \infty$, the first three equations in (1) have a unique solution u, expressible by means of the Poisson-Weierstrass kernel; this solution is seen to satisfy the fourth equation in (1) if and only if a(t) satisfies the nonlinear integral equation

$$a(t) = \frac{\pi^{1/2}\, g(t)}{\int_0^t f'(\tau)\left[\int_\tau^t a(y)\,dy\right]^{-1/2} d\tau}.$$

Define the mapping $a \to La$ by $La(t) = a(t)$, then, under the assumption that $H(t) = L1(t)$ approaches a positive limit as $t \to 0+$ (which implies that $f'(t) \to \infty$ as $t \to 0+$) the author shows that L has a unique fixed point. This is done by showing that L maps the set of continuous functions h(t) satisfying

$$\inf_{0 < \tau < t} H^2(\tau) \le h(t) \le \sup_{0 < \tau < t} H^2(t)$$

into an equicontinuous subset of itself; then, using the monotonicity of L, the solution a may be constructed. (Math. Rev. abstract)

2625

Rice U. [Dept. of Mathematics] Houston, Tex.

CLASS D SUPERMARTINGALES, by G. Johnson and L. L. Helms. [1962] [4]p. (AFOSR-3445) (AF AFOSR-62-233) AD 407895 Unclassified

Also published in Bull. Amer. Math. Soc., v. 69: 59-62, Jan. 1963.

A decomposition for positive supermartingales $\{y_t,\ 0 \le t \le \infty\}$ is derived whose sample functions are right continuous under the hypothesis H that the family $\{y_t\}$ where T runs through the class of process stopping times, is uniformly integrable. The question whether uniform integrability of the process random variables implies H was left open. A counterexample to this implication is exhibited. Under the added hypothesis of sample function continuity a necessary and sufficient condition for H, not involving stopping times is found. (Math Rev. abstract)

2626

Rochester U. Dept. of Chemistry, N. Y.

THE TRIPLET STATE OF BENZENE, by H. Ishikawa W. A. Noyes, Jr. [1962] [1]p. incl. refs. (AFOSR-2364) (AF 49(638)679) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1502, 1962.

The first excited triplet state of benzene has been identified through emission from a glassy matrix and possibly through weak absorption from the ground state. Some reactions of the triplet state of benzene are briefly discussed. The fate of the triplet state molecules is at present unknown, several possibilities are presented: (1) they cross over to the ground state with ultimate loss of vibration energy by collision; (2) they are discharged on the walls; and (3) they undergo reaction to an intermediate which reverts ultimately to normal benzene.

2627

Rochester U. Dept. of Chemistry, N. Y.

PHOTOSENSITIZATION BY BENZENE VAPOR: BIACETYL. THE TRIPLET STATE OF BENZENE, by H. Ishikawa and W. A. Noyes, Jr. [1962] 36p. incl. diagrs. tables, refs. (AFOSR-2427) (AF 49(638)679) AD 432681 Unclassified

Also published in Jour. Chem. Phys., v. 37: 583-591, Aug. 1, 1962.

Biacetyl strongly quenches the fluorescence of benzene vapor. There is a resulting dissociation of biacetyl which occurs presumably because the second excited singlet state of biacetyl is produced by energy transfer from the benzene. Emission by biacetyl also occurs, but the ratio of phosphorescence to fluorescence is very large and may be infinity. The triplet state of biacetyl seems to be produced preferentially by energy transfer from a triplet state of benzene. Emission efficiencies are such that nearly every singlet-state molecule of benzene which does not fluoresce must undergo an intersystem crossover to the triplet state. Since this crossover predominates over fluorescent emission, the life of the singlet state of benzene is presumably determined mainly by the crossover. The effective cross section for self-quenching of the singlet state of benzene is about 0.036×10^{-16} cm^2, while the effective cross section for quenching by biacetyl is about 2.5×10^{-16} cm^2. Since the life of the triplet state of benzene in the gas phase is not known, cross sections for reactions of this state may not be calculated (Contractor's abstract)

2628

Rochester U. Dept. of Chemistry, N. Y.

THE TRANSFER OF ELECTRONIC ENERGY FROM BENZENE TO BIACETYL, by H. Ishikawa. 1962. [38]p. incl. diagrs. tables, refs. (AFOSR-2437) (AF 49(638)679) Unclassified

The purpose of this work is to study the mechanism of transfer of energy, particularly electronic energy, between polyatomic molecules. Benzene is used as an energy donor and biacetyl as an energy acceptor in this work. A study of energy transfer from benzene vapor to biacetyl vapor after the former has absorbed radiation at 2537A has revealed 2 phenomena of photosensitization: (1) the sensitized decomposition of biacetyl (however, not conclusively); and (2) the sensitized emission of biacetyl. The sensitized decomposition of biacetyl may be explained as a result of energy transfer from singlet excited benzene to biacetyl exciting the latter to the second upper singlet state. The data of the emission of biacetyl sensitized by benzene may best be treated by assuming the presence of triplet state benzene in high concentration which will be formed from singlet excited state benzene by intersystem crossing. As a mechanism of sensitized biacetyl emission, energy transfer from triplet benzene to biacetyl is proposed. (Contractor's abstract, modified)

2629

Rochester U. Dept. of Chemistry, N. Y.

ENERGY DISSIPATION FROM EXCITED ACETALDEHYDE MOLECULES, by C. S. Parmenter and W. A. Noyes, Jr. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-J320) (AF 49(638)679) AD 408023 Unclassified

Also published in Jour. Amer. Chem. Soc., v, 85: 416-421, Feb. 20, 1963.

Energy dissipation in acetaldehyde vapor following absorption at various wave lengths from 2537 to 3340A has been studied. At the longer wave lengths dissociation and intersystem crossover to the ground state from a triplet state account for most of the dissipation. At shorter wave lengths dissociation becomes of increasing importance. This dissociation probably occurs from high vibration levels of the singlet state but the possibility of rapid transition through a triplet state cannot be excluded. As shown previously by other authors, the mode of dissociation changes with wave length. (Contractor's abstract)

2630

Rochester U. Dept. of Chemistry, N. Y.

THE PHOTOCHEMISTRY OF MIXTURES OF 2-PENTANONE AND 2-HEXANONE WITH BIACETYL, by J. L. Michael and W. A. Noyes, Jr. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-J667) (AF 49(638)679) AD 415469 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1027-1032, Apr. 20, 1963.

Energy transfer to biacetyl molecules occurs from 2-pentanone and from 2-hexanone molecules excited at 3130 A. Evidence is found in sensitized biacetyl emission. The emission caused by pentanone is about 20 times as intense as that caused by hexanone. Biacetyl markedly reduces the non-free radical dissociation of 2-pentanone into ethylene and acetone at 3130 A, but the yield of carbon monoxide increases although it is always low. The effect of biacetyl on the hexanone at 3130 A is negligible. Energy transfer to biacetyl and dissociation into ethylene and acetone both seem to come from the same state for the pentanone. There is a weak sensitized emission caused by 2-pentanone at 2537 A and a marked increase in carbon monoxide yield. For hexanone the effects are small, although there is some increase of carbon monoxide yield The evidence indicates that the direct photochemical dissociation of 2-pentanone into ethylene and acetone occurs from an excited singlet state.

Evidence herein presented is not sufficiently definite to permit conclusions about 2-hexanone. (Contractor's abstract)

2631

Rochester U. Dept. of Chemistry, N. Y.

THE PHOTOCHEMISTRY OF METHYLAMINE, by J. V. Michael and W. A. Noyes, Jr. [1962] [6]p. incl. tables, refs. (AFOSR-J668) (AF 49(638)679) AD 415395 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1228-1233, May 5, 1963.

Hydrogen, methane, nitrogen, ethane, ammonia, ethylenimine, dimethylamine, azomethane and a polymer have been identified as products in the photochemical decomposition of methylamine. Quantum yields of most of these products have been determined under a variety of experimental conditions at room temperature. By use of CH_3ND_2 and of CD_3NH_2 as well as by use of scavengers it has been shown that the main primary process is the elimination of a hydrogen atom. This is followed by abstraction from the substrate to form hydrogen gas. Other steps in the mechanism are suggested and evidence for some of them presented. (Contractor's abstract)

2632

Rochester U. [Dept. of Physics and Astronomy] N. Y.

GROWTH OF FLUCTUATIONS IN A UNIFORMLY CONTRACTING OR EXPANDING CLOUD, by M. P. Savedoff and S. Vila. [1962] [6]p. incl. table. (AFOSR-J131) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)52 and Alfred P. Sloan Foundation) AD 400193 Unclassified

Also published in Astrophys. Jour., v. 136: 609-614, Sept. 1962.

Since no gas sphere in hydrostatic equilibrium is unstable to radially symmetric perturbations, provided that $\Gamma > 4/3$ and that the density increases with depth, the stability of a model without hydrostatic equilibrium is investigated. This model has been discussed by Ebert and Bonnor and is characterized by a uniform density, pressure, and expansion or contraction. Since in the absence of pressure gradients each element is in free fall, one erroneously expects that Jean's criterion determines stability. For the zero energy case (corresponding to parabolic motion), the system is unstable for all $\Gamma < 5/3$ independent of the Jeans criterion. For expansion, the Jeans criterion separates unstable from stable motion when $\Gamma = 4/3$ while all larger values of Γ the motion is unstable; independent again of the Jeans criterion. Exact solutions are given for non-zero energy (elliptical and hyperbolic motion) for special values of Γ, and asymptotic solutions valid for several ranges of Γ are given. The existence of unstable solutions suggests, but does not prove, the possibility of fragmentation into stable protostars or protogalaxies.

2633

Rochester U. Dept. of Physics and Astronomy, N. Y.

THE ABUNDANCE OF TRITONS AND DEUTERONS IN PRIMARY COSMIC RADIATION, by M. V. K. Appa Rao and P. J. Lavakare. [1962] [8]p. incl. diagrs. refs. (AFOSR-4125) (AF 49(638)303) AD 446522 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 311, Apr. 23, 1962.

Also published in Nuovo Cimento, Series X, v. 26: 740-747, Nov. 16, 1962.

An attempt was made to determine the abundance of low-energy tritons and deuterons in a nuclear emulsion stack exposed at a geomagnetic latitude, $\lambda = 61°N$ on Aug. 3, 1958 under 3.8 g/cm^2 of matter. Some of the implication of the results are discussed. However, due to the uncertainty of the correction for secondary production within the atmosphere, the results are consistent with the absence of these elements in primary cosmic radiation.

2634

Rochester U. Dept. of Physics and Astronomy, N. Y.

THEORETICAL STUDIES OF EFFECTS OF COHERENCE IN ELECTROMAGNETIC RADIATION, by E. Wolf. Final rept. May 1959-Dec. 1961. May 1962, 16p. incl. refs. (AFOSR-2656) (AF 49(638)602) AD 278260 Unclassified

The investigations carried out under this contract may be grouped under the following headings: Coherence properties of electromagnetic radiation; Properties of photon beams; Diffraction and related investigations; and Surveys of current research on coherence and fluctuations.

2635

Rochester U. Dept. of Physics and Astronomy, N. Y.

COHERENCE FUNCTIONS OF BLACKBODY RADIATION (Abstract), by E. Wolf and Y. Kano. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)602] and United Aircraft Corp.) Unclassified

Presented at meeting of the Opt. Soc. Amer., Washington, D. C., Spring, 1962.

Published in Jour. Opt. Soc. Amer., v. 52: 596, May 1962.

R. C. Bourret discussed certain correlation functions of blackbody radiation. These functions are a measure of the correlation between the electric-field vectors at 2 points in space, at 2 instants of time. In the present paper, an extension of Bourret's analysis is described, concerned with determination of the complex degree of coherence of blackbody radiation. This quantity is essentially the complex analytic signal associated with one of the real correlation functions considered by Bourret. The behavior of the analytic continuation of the temporal, complex degree of coherence $\gamma_{11}(\tau)$ into the lower half of the complex τ-plane is examined. It is shown that this analytic continuation has no zeros anywhere in this half-plane, and also that $\gamma_{11}(\tau)$ has no zeros on the real τ-axis. This result in turn implies that the phase function of the temporal, complex degree of coherence of blackbody radiation is a "minimal phase function." This conclusion lends support to the theory relating to the possibility of complete determination of energy distribution in certain asymmetric spectra from measurements of visibility of interference fringes alone.

2636

Rochester U. Dept. of Physics and Astronomy, N. Y.

COMPARISON OF THREE THEORIES OF ELECTROMAGNETIC DIFFRACTION (Abstract), by B. Karczewski and E. Wolf. [1962] [1]p. [AF 49(638)602] Unclassified

Presented at meeting of the Opt. Soc. Amer., Washington, D. C., Spring 1962.

Published in Jour. Opt. Soc. Amer., v. 52: 600, May 1962.

In recent papers one of the authors studied on the basis of the theories of Kottler, Severin, and Vasseur, the distribution of the energy density in the far field of an electromagnetic wave diffracted from an aperture. In the present paper, this investigation is carried further by comparing the predictions relating to the state of polarization of the far field. Polarized as well as unpolarized incident fields are considered. The coherency matrices of the far field, appropriate to the theories of Kottler, Severin, and Vasseur are derived and with their help the state of polarization is analyzed. It is found that for all but small angles of diffraction the 3 theories predict substantially different behavior. Thus, a comparison of the results of the present investigation with the corresponding polarization measurements would afford a relatively simple test as to the validity of the theories under conditions that are commonly encountered in optics. Such a comparison might also help to resolve a long-standing controversy as to the correctness of Kottler's definition of a black screen.

2637

Rochester U. Dept. of Physics and Astronomy, N. Y.

IS A COMPLETE DETERMINATION OF THE ENERGY DISTRIBUTION IN SPECTRAL LINES POSSIBLE FROM MEASUREMENTS OF THE VISIBILITY OF INTERFERENCE FRINGES? (Abstract), by E. Wolf. [1962] [1]p. [AF 49(638)602] Unclassified

Presented at meeting of the Opt. Soc. Amer., Washington, D. C., Spring 1962.

Published in Jour. Opt. Soc. Amer., v. 52: 596, May 1962.

A well-known method due to Michelson provides information about the energy spectrum of a light source from measurements of the visibility of interference fringes. It is generally believed, and has in fact been first explicitly asserted so by Rayleigh, that unless the spectrum is symmetric the complete spectral profile cannot be determined from visibility measurements alone. The apparent reason for this is that the visibility is proportional to the modulus of the Fourier transform of the energy spectrum and hence does not yield separately the cosine and the sine transforms. Thus, a Fourier inversion does not appear to be possible except when, on account of symmetry of the spectrum, the sine transform may be assumed to be zero. It is shown that the above argument is inconclusive because it fails to take into account the analytic properties of the Fourier transform of the energy spectrum. These properties, which are playing an increasingly important role in current researches on coherence properties of light are shown to impose a lower bound on the phase function of the Fourier transform. A theory is put forward, according to which the actual phase function of the Fourier transform of many asymmetric profiles is either this "minimal phase function" or differs from it by an insignificant amount. Such profiles could be completely determined from the knowledge of the visibility curve alone. A possible departure from the minimal phase solution raises some interesting, unsolved problems. The theory has a close bearing on the recently proposed square-law detection techniques and coincidence counting methods for the analysis of very narrow spectra, such as those encountered in the output from an optical maser.

2638

Rochester U. Dept. of Physics and Astronomy, N. Y.

MEASURES OF BANDWIDTH AND COHERENCE TIME IN OPTICS (Abstract), by L. Mandel and E. Wolf. [1962] [1]p. [AF 49(638)602] Unclassified

Presented at annual meeting of the Opt. Soc. Amer., Rochester, N. Y., [1962]

Published in Jour. Opt. Soc. Amer., v. 52: 1322, Nov. 1962.

Several different definitions of the coherence time $\Delta\tau$ can be found in the literature. It is generally assumed that in cases of practical interest, the different definitions give values of the same order of magnitude. The same remark applies also to definitions of the effective bandwidth $\Delta\nu$. It is generally assumed that these 2 quantities are related by the order of magnitude formula $\Delta\tau \sim 1/\Delta\nu$. It is shown from detailed examination of one particular case of practical interest that the bandwidths as defined by 2 of the previously proposed formulas are quite different orders of magnitude, although the correspondingly defined coherence times differ only by a factor of the order of unity. This example shows that the reciprocity relation $\Delta\tau \sim 1/\Delta\nu$ must be treated with caution, especially in the case of multiple peaked distributions, such as found in the spectrum of optical-maser beams.

2639

Rochester U. Dept. of Physics and Astronomy, N. Y.

THE INFLUENCE OF IONIZATION LOSS ON THE SHAPE OF THE DIFFERENTIAL PRIMARY COSMIC RAY ENERGY-SPECTRUM, by M. V. K. Appa Rao and M. F. Kaplon. [1962] [18]p. incl. diagrs. refs. (AFOSR-4127) (AF AFOSR-62-32) AD 446405
Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 700-717, Feb. 1, 1963.

The effect of ionization loss on a primary cosmic ray spectrum of the form $N_{A,Z}(\epsilon) = K(A, Z)\,\gamma/\epsilon^{\gamma+1}$ is calculated for H^1, Be^9, C^{12}, F^{19}, Al^{27}, Ca^{40} and Fe^{56} as representative of the charge spectrum of primary cosmic rays. The calculation is carried out for passage through 2, 4, 6, and 10 g/cm^2 of hydrogen and also for a model in which the amount of material traversed is inversely proportional to the momentum. The observable effects obtained, i.e. the shift of the maximum towards higher velocity with increasing Z and the relative enrichment of the lighter nuclei/energy interval at low energies are compared with the experimental data obtainable. Some discussion of the implications for aspects of the origin of cosmic rays is given.

2640

Rochester U. Dept. of Physics and Astronomy, N. Y.

ISOTOPIC ANALYSIS OF PRIMARY COSMIC RADIATION, by M. V. K. Appa Rao. [1962] [7]p. incl. refs. (AFOSR-4128) (AF- AFOSR-62-32) AD 446529
Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 693-699, Feb. 1, 1963.

It is proposed that the characteristics of nuclear interactions of primary cosmic-ray nuclei (in-out interaction) be used to obtain the isotope abundance ratios for different charges. The applications of the procedure to singly and doubly charged nuclei is discussed. (Contractor's abstract)

2641

Rochester U. Dept. of Physics and Astronomy, N. Y.

ON THE ENERGY DEPENDENCE OF FRAGMENTATION OF COSMIC RAY NUCLEI IN INTERSTELLAR SPACE, by H. H. Aly and M. V. K. Appa Rao. Nov. 2, 1962 [18]p. incl. diagrs. refs. (Rept. no. NYO 10249) (AFOSR-4421) (AF AFOSR-62-32)
Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 457-465, May 1, 1963. (AFOSR-40513; AD 434420)

The energy-dependence of fragmentation probabilities for cosmic ray nuclei in interstellar hydrogen is investigated, using the data that exist from experiments in which protons of various energy bombard different nuclei. The probability of a medium nucleus (C, N, O, F) going into a light nucleus (Li, Be, B) in an interaction of a medium nucleus in hydrogen (P_{ML}) seems to be energy-independent up to energies of the order of 6 gev/nucleon, whereas the probability of a heavy nucleus (Z >10) going into a light nucleus (P_{HL}) seems to be strongly energy-dependent. The above results imply that the interstellar matter traversed by cosmic ray nuclei as deduced from the abundance of light nuclei is dependent on the energies under consideration. The maximum possible difference between the values deduced at low energy (< 500 mev/nucleon) and the value deduced at high energy (> 1.5 gev/nucleon) is about 2 g/cm^2, if the experimentally measured ratio (Li, Be, B)/(C, N, O, F) is the same at the 2 energy ranges, the value at lower energies being higher. (Contractor's abstract)

2642

Rochester U. Dept. of Physics and Astronomy, N. Y.

ON THE ENERGY DEPENDENCE OF FRAGMENTATION OF COSMIC RAY NUCLEI IN INTERSTELLAR SPACE, by H. H. Aly and M. V. K. Appa Rao. [1962] [9]p. incl. diagrs. refs. (AFOSR-64-0513) (AF AFOSR-62-32)
Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 457-465, May 1, 1963.

For abstract see item no. 2641, Vol. VI.

2643

Rochester U. Dept. of Physics and Astronomy, N. Y.

STUDY OF NUCLEAR INTERACTIONS PRODUCED BY 275 MEV DEUTERONS IN NUCLEAR EMULSIONS,

by M. V. K. Appa Rao and P. J. Lavakare. [1962] [5]p. incl. diagrs. refs. (AFOSR-64-0514) (AF AFOSR-62-32) AD 434318 Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 321-325, July 16, 1963.

Nuclear interactions produced in nuclear emulsions by deuterons of mean energy 275 mev have been studied. The mean free path for deuterons of this energy is found to be (16. 6 ± 1. 8) cm.

2644

Rochester U. Dept. of Physics and Astronomy, N. Y.

A SEARCH FOR HIGH-ENERGY COSMIC γ-RAYS IN EMULSIONS, by J. Klarmann. [1962] [6]p. incl. diagrs. refs. (AFOSR-64-2038) (AF AFOSR-62-32) AD 452511 Unclassified

Also published in Nuovo Cimento, Series X, v. 24: 540-545, May 1, 1962.

The possibility of employing nuclear emulsions as a detector for γ radiation from celestial sources was tested in a balloon flight over Texas. An average downward flux of 0. 27 photons/cm^2 s sr was found during ascent and descent of the balloon in a solid angle of 0. 842 sr. An upper limit to the flux of γ-rays at an altitude of between 3 and 4. 5 gm/cm^2 was determined as $1.7 \cdot 10^{-2}$ photons/cm^2 sr. An upper limit to the albedo flux during ascent and descent is given by $2.5 \cdot 10^{-2}$ photons/cm^2 s sr. The results on scanning time and scanning efficiency in Ilford G-5 emulsions were not too encouraging. (Contractor's abstract)

2645

Rochester U. [Dept. of Physics and Astronomy] N. Y.

SCREENING CORRECTION TO THE SLATER EXCHANGE POTENTIAL, by J. E. Robinson, F. Bassani and others. [1962] [3]p. incl. diagrs, refs. (AFOSR-4075) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-145 and Atomic Energy Commission) Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 215-217, Sept. 1, 1962.

Modifying the original Slater calculation to include the influence of electron correlation on pair interaction (but still within the approximation of a uniform electron gas) has the effect of decreasing sharply the Slater exchange potential in the regions of low electronic density, where it was known to be too high. The Coulomb interaction is in effect replaced by a screened interaction, the simplest form of the screening factor resulting from the linearized Thomas-Fermi dielectric function. The quantitative effect of the correlation factor is demonstrated by a calculation of the exchange potential for Cl^- in a chloride. It may be very important in various types of band structure calculations.

2646

Rochester U. [Dept. of Physics and Astronomy] N. Y.

RELATION BETWEEN ABSORPTION AND EMISSION PROBABILITIES IN LUMINESCENT CENTERS IN IONIC SOLIDS, by W. B. Fowler and D. L. Dexter, [1962] [12]p. incl. diagr. refs. (AFOSR-J158) [AF AFOSR-62-145] AD 400091 Unclassified

Also published in Phys. Rev., v. 128: 2154-2165, Dec. 1, 1962.

The Einstein relationship between spontaneous emission probability for radiative transitions is not generally valid for impurity centers in condensed media. An alternative approach to the problem is available by which estimates of the possible discrepancies can be made. Several mechanisms are discussed, particularly the Jahn-Teller effect, which depend on the existence of the phonon field and the lattice relaxation following absorption of a photon. In some simple cases, such as the F center in KCl and LiF, the decay time predicted from the integrated absorption cross section may differ by an order of magnitude from that observed. In other simple and cubic systems, where the atomic symmetries are appropriate, the discrepancy may be even larger. In noncubic crystals similar discrepancies may be expected. (Contractor's abstract)

2647

Rochester U. Dept. of Physics and Astronomy, N. Y.

SUPERCONDUCTIVITY IN THE CASE OF OVERLAPPING BANDS, by M. Suffczynski. [1962] [2]p. (AFOSR-J163) [AF AFOSR-62-145] AD 400089 Unclassified

Also published in Phys. Rev., v. 128: 1538-1539, Nov. 15, 1962.

The equations for the superconductivity energy gap and transition temperature in the case of overlapping bands are derived by the Nambu-Schrieffer formalism. (Contractor's abstract)

2648

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ULTRAVIOLET ABSORPTION OF SOLID ARGON, KRYPTON, AND XENON, by G. Baldini. [1962] [6]p. incl. diagrs. table, refs. (AFOSR-J270) [AF AFOSR-62-145] AD 400882 Unclassified

Also published in Phys. Rev., v. 128: 1562-1567, Nov. 15, 1962.

The absorption spectra of thin films of argon, krypton, and xenon were measured between 20 and 50°K in the region from 1600 to 900A (8 to 14 ev). The spectra show: (1) strong doublets corresponding to the atomic resonance doublets, (2) lines apparently of nonatomic nature, and (3) absorption continua. The experimental results are discussed in terms of the Frenkel and Wannier exciton models and the band gaps are estimated. Reasonable agreement is found between experimental results and available theoretical predictions. (Contracctor's abstract)

2649

Rochester U. [Dept. of Physics and Astronomy] N. Y.

COOPERATIVE OPTICAL ABSORPTION IN SOLIDS, by D. L. Dexter. [1962] [2]p. (AFOSR-J591) (AF AFOSR-62-145) AD 413799 Unclassified

Presented at Internat'l. Conf. on Crystal Lattice Defects, Kyoto (Japan) Sept. 7-12, 1962.

Also published in Jour. Phys. Soc. Japan., v. 18, Suppl. II: 275-276, Mar. 1963.

For abstract see item no. 2663, Vol. VI.

2650

Rochester U. [Dept. of Physics and Astronomy] N. Y.

THE FINE STRUCTURE OF ABSORPTION IN NaCl: Ag, by R. S. Knox. [1962] [7]p. incl. diagrs. table, refs. (AFOSR-J604) (AF AFOSR-62-145) AD 414204 Unclassified

Presented at Internat'l. Conf. on Crystal Lattice Defects, Kyoto (Japan) Sept. 7-12, 1962.

Also published in Jour. Phys. Soc. Japan, v. 18, Suppl. II: 268-274, Mar. 1963.

It is known that a low concentration of Ag^+ introduces weak lines into the absorption spectrum of NaCl near the fundamental edge. The small observed oscillator strengths of these lines lend considerable plausibility to their assignment to perturbed $4d^{10} \rightarrow 4d^9 5_s$ transitions in the silver ions as originally proposed by Seitz, but certain theoretical calculations seem to indicate, on the basis of energy level predictions, that perturbed $4d^9 5_p$ states are directly involved as final states. In this note, the relative strengths and positions of the observed lines are shown to be consistent with the original $4d^9 5_s$ assignment, on the basis of a semi-empirical crystal-field study and an analysis of their temperature dependence. (Contractor's abstract)

2651

Rochester U. Dept. of Physics and Astronomy, N. Y.

BAND STRUCTURE OF WHITE TIN, by M. Miasek. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-J696) (AF AFOSR-62-145) AD 414168 Unclassified

Also published in Phys. Rev., v. 130: 11-16, Apr. 1, 1963.

A perturbation calculation of the band structure in white tin is performed using the orthogonalized plane wave approximation. The energies are determined for several points of high symmetry of the Brillouin zone for different choices of potential. On the basis of these results the properties of the Fermi surface in the neighborhood of these points are discussed. It is found that the first 2 Brillouin zones are completely filled with electrons.

2652

Rochester U. Dept. of Physics and Astronomy, N. Y.

WANNIER EXCITONS IN SIMPLE VAN DER WAALS CRYSTALS, by R. S. Knox. [1962] [6]p. incl. refs. (AFOSR-J1559) (AF AFOSR-62-145) AD 427640 Unclassified

Presented at 10th Annual meeting of the Radiation Research Soc., Colorado Springs, May 20-23, 1962.

Also published in Radiation Research, v. 20: 77-82, Sept. 1963.

It is proposed that the Wannier model can be usefully applied to exciton states in the solid rare gases, and it has been shown that all but the lowest ($n = 1$) states in solid argon appear to be good Wannier states. For the lowest state, the model is inapplicable in detail but at least provides an alternative to the Frenkel model which, because of the large spatial extent of excited rare-gas orbitals, also appears to be inadequate. The lowest exciton state is not to be regarded as totally unexplained; rather it is only the fine details of the internal charge distribution of this state which remain to be elucidated. Physically, this state may be regarded as a hole in the p^6 shell of the atom, to which is bound an electron in some totally symmetric state resembling a highly perturbed 4s electron orbital or a complicated linear combination of Ar^- 4s orbitals on nearby neighbors. It is remarkable that in all rare gases the energy of the lowest state so closely matches the corresponding atomic excitation energy (in solid argon, where the difference is greatest, there is a blue shift of only 0.5ev.). The Wannier model can be used in more complicated molecular crystals, and this paper illustrates its properties and limitations.

2653

Rochester U. Dept. of Physics and Astronomy, N. Y.

OPTICAL ABSORPTION BY A PAIR OF IONS, by D. L. Dexter [1962] [2]p. (AFOSR-J560) (AF AFOSR 62-145) AD 427584 Unclassified

Presented at 10th Annual meeting of the Radiation Research Soc., Colorado Springs, May 20-23, 1962.

Also published in Radiation Research, v. 20: 118-119, Sept. 1963.

Varsanyi and Dieke have demonstrated unequivocably the absorption of a single photon by a pair of rare-earth ions in a crystal, acting in cooperation. Neither ion by itself could possibly absorb the photon, since no single-ion state exists at the photon energies involved. Absorption of light occurs discretely at sums of energy-level separation in the 2 ions is detected experimentally by the excitation spectrum of 1 of the emission lines. The basic reason this phenomenon is so unusual is related to the fact that the interaction of radiation with matter consists of a sum of 1-electron operator, $\vec{A}_i \cdot \vec{\Delta}_i$, where $\vec{A}$ is the vector potential. From this point of view, only 1 electron at a time could possibly be excited, hence only 1 ion. In this paper a procedure for computing the probability of this effect is outlined, and some of the implications of the associated phenomena are discussed.

2654

Rochester U. [Dept. of Physics and Astronomy] N. Y.

VALENCE BAND STRUCTURE OF SILVER CHLORIDE, by R. S. Knox, F. Bassani, and W. B. Fowler, Jr. [1962] [4]p. incl. diagrs. (AFOSR-J1576) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-145] and Atomic Energy Commission) AD 427589 Unclassified

Also published in Photog. Sensitivity, v. 3: 11-14, Sept. 1962.

Preliminary calculations of the band structure of AgCl were made by using a combination of the tight binding and orthogonalized plane wave (OPW) methods. The results confirm Seitz's speculation on the nature of AgCl (Rev. Mod. Phys., v. 23: 328, 1951) and provide a specific prediction of the wave vector (111) of the phonons which may be expected to participate in the production of the indirect spectrum of AgCl. Assuming that the conduction band of AgCl is simple, the computation shows that the difference between the indirect and the direct band gap (at Γ) is 1.86 ev.

2655

Rochester U. Dept. of Physics and Astronomy, N. Y.

IS A COMPLETE DETERMINATION OF THE ENERGY SPECTRUM OF LIGHT POSSIBLE FROM MEASUREMENTS OF THE DEGREE OF COHERENCE? by E. Wolf. [1962] [8]p. incl. refs. (AFOSR 2128) (AF AFOSR-62-246) AD 414162 Unclassified

Also published in Proc. Phys. Soc., (London) v. 80: 1269-1272, 1962.

It is shown that the analytic properties of the temporal complex degree of coherence $\gamma(\tau)$ impose a relationship between modulus of (τ complex) and arg ($\gamma(\tau)$ on the real time axis. This relationship involves, in general, the location of the zeros of the degree of coherence in the lower half of the complex (τ) plane. It is suggested that the analytic continuation of the temporal degree of coherence of many spectral distributions has no zeros at all in this half plane. The spectral profiles of such distributions could be uniquely determined from measurements of modulus of $\gamma(\tau)$ alone. This possibility is of interest in connection with Michelson's well-known method of visibility curves. It is also of interest in connection with the recently proposed correlation and coincidence techniques (employing square-law detection) for determining narrow spectral profiles, such as those found in the output from an optical maser.

2656

Rochester U. Dept. of Physics and Astronomy, N. Y.

THE MEASURES OF BANDWIDTH AND COHERENCE TIME IN OPTICS, by L. Mandel and E. Wolf. [1962] [4]p. incl. diagrs. refs. [Technical note no. 3] (AFOSR-J119) (AF AFOSR-62-246) AD 400078 Unclassified

Also published in Proc. Phys. Soc. (London). v. 80: 894-897, 1962.

Several different definitions of the coherence time $\Delta\tau$ can be found in the literature and it is generally assumed that, in cases of practical interest, the different definitions give values of the same order of magnitude. The same remark applies also to definitions of the effective bandwidth $\Delta\nu$. Moreover it is generally supposed that these 2 quantities are related by the order of magnitude formula $\Delta\tau \sim 1/\Delta\nu$. It is shown from a detailed examination of one particular case of practical interest that the bandwidths as defined by 2 of the previously proposed formulae are of quite different orders of magnitude, although the correspondingly defined coherence times differ only by a factor of order unity. Similarly it may happen that the 2 values of $\Delta\tau$ differ greatly, whereas the corresponding values of $\Delta\nu$ are nearly equal. This discussion shows that the reciprocity relation $\Delta\tau \sim 1/\Delta\nu$ must be treated with caution, especially in the case of multiple-peaked distributions, such as arise in optical masers. (Contractor's abstract)

2657

Rochester U. Dept. of Physics and Astronomy, N. Y.

TEMPORAL COHERENCE OF BLACKBODY RADIATION, by Y. Kano and E. Wolf. [1962] [4]p. incl. diagr. (AFOSR-J508) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-246 and United Aircraft Corp.) AD 616223 Unclassified

Also published in Proc. Phys. Soc. (London), v. 80: 1273-1276, 1962.

The temporal complex coherence function of blackbody radiation is calculated and is found to be expressible in terms of the generalized Riemann ζ-function. Curves are given which show the variation of the absolute value and of the argument of the temporal complex degree of coherence $\gamma(\tau)$ as functions of increasing time delay τ. It is shown that the analytic continuation of $\gamma(\tau)$ has no zeros in the lower half of the complex τ plane. This result supports the theory proposed in the paper by Wolf (item no. 2655) about the possibility of determining certain energy spectra from measurements of the absolute value of the degree of coherence.

2658

Rochester U. Dept. of Physics and Astronomy, N. Y.

COHERENCE-TIME AND EFFECTIVE BANDWIDTH OF BLACKBODY RADIATION, by C. L. Mehta. [1962] [8]p. incl. table, refs. (AFOSR-J589) (AF AFOSR-62-246) AD 413772 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 401-408, Apr. 16, 1963.

The coherence-time and the effective bandwidth of blackbody radiation are calculated on the basis of definitions proposed for these quantities by Wolf and Mandel. The 2 sets of definitions are found to give results of the same order of magnitude. The coherence-time at room temperature (~ 300°K) is found to be about $2 \cdot 10^{-14}$ S, corresponding to a coherence-length in vacuum of $6 \cdot 10^{-4}$ cm. A table of corresponding values for various temperatures is given. (Contractor's abstract)

2659

Rochester U. Dept. of Physics and Astronomy, N. Y.

BOUNDARY WAVE IN ELECTROMAGNETIC THEORY OF DIFFRACTION, by B. Karczewski. [1962] [2]p. incl. diagr. (AFOSR-J879) (AF AFOSR-62-246) AD 416009 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 878-879, July 1963.

The Luneberg-Severin-Vasseur (LSV) theory which solves a diffraction problem of electromagnetic (vector) wave on an aperture in an infinite plane and perfectly conducting screen, as a one-side boundary-value problem (condition $E_{tan\ g} = 0$ is fulfilled on $z = \pm 0$) is considered. Unperturbed field is assumed on the aperture. The LSV theory described a diffracted electromagnetic field behind the screen in terms of double integrals, extended over the aperture. The purpose of the present note is to transform these double integrals into single integrals taken along the boundary of the aperture plus some terms corresponding to the geometrical wave. In doing this, it becomes possible to establish the existence, in the framework of the LSV theory, of a boundary electromagnetic wave for the case of an arbitrary wave incident on an aperture.

2660

Rochester U. Dept. of Physics and Astronomy, N. Y.

POLARIZATION PROPERTIES OF THE ELECTROMAGNETIC FIELD DIFFRACTED FROM AN APERTURE, by B. Karczewski and E. Wolf. [1962] [3]p. [AF AFOSR-62-246] Unclassified

Published in Electromagnetic Theory and Antennas; Proc. Symposium, Copenhagen (Denmark) June 25-30, 1962), ed. by E. C. Jordan. Oxford, Pergamon Press, pt. 2: 797-799, 1963.

Predictions regarding the state of polarization of the field are deduced. The main concern is the case when the incident field is a quasi-monochromatic unpolarized plane wave. It is shown that there are marked differences as between the approximate theories of Hottier, Severin and Vasseur, in their predictions of the state of polarization of the far field, even at moderate angles of diffraction. The mathematical approach is based on Wolf's coherency matrix.

266i

Rochester U. Dept. of Physics and Astronomy, N. Y.

A BOUNDARY WAVE THEORY OF DIFFRACTION AT AN APERTURE, by E. Wolf, E. Marchand, and K. Miyamoto. [1962] [3]p. (AFOSR-J1307) [AF AFOSR-63-237] AD 424839 Unclassified

Also published in Electromagnetic Theory and Antennas; Symposium, Copenhagen (Denmark) (June 25-30, 1962), ed. by E. C. Jordan. Oxford, Pergamon Press, pt. 1: 109-111, 1963.

An account is given of some of the results obtained with different approximations for the Green's type integral representation of the solution of the Helmholtz equation as the sum of a boundary wave and $\Sigma F_j(P)$, where $F_j(P)$ is the contribution from a singularity Q_j of the vector potential.

2662

Rochester U. Inst. of Optics, N. Y.

THEORETICAL INVESTIGATIONS OF THE EFFECTS OF IMPERFECTIONS ON THE OPTICAL PROPERTIES OF SOLIDS, by D. L. Dexter. Final rept. Feb. 1962, 15p. incl. refs. (AFOSR-2247) (AF 49(638)432) AD 289184 Unclassified

A brief summary of the experimental and theoretical work concerning the optical and electrical properties of solids is presented.

2663

Rochester U. [Inst. of Optics] N. Y.

COOPERATIVE OPTICAL ABSORPTION IN SOLIDS, by D. L. Dexter. Jan. 1962 [20]p. incl. diagrs. (Technical rept. no. 9) (AFOSR-2271) (AF 49(638)432) AD 289483 Unclassified

Also published in Phys. Rev. v. 126: 1962-1967, June 15, 1962.

A discussion is given of a mechanism for resonance energy transfer in the absorption of light by a pair of neighboring ions in a crystal, as recently demonstrated by Varsanyi and Dieke. An estimate of the probability for this process is given. (Contractor's abstract)

2664

Rochester U. [Inst. of Optics] N. Y.

CRITIQUE OF THE PEKAR THEORY OF THE F-CENTER, by W. B. Fowler and D. L. Dexter. Apr. 1962 [18]p. incl. diagrs. tables, refs. (AFOSR-4461) [AF 49(638)433] AD 295912 Unclassified

Also published in Phys. Stat. Sol., v. 2: 821-828, 1962.

A discussion is presented of the Pekar treatment of optical absorption and emission by the F-center in alkali halides, in which the crystal is treated as a polarizable dielectric continuum. In some important respects this is the most successful theory yet developed; nevertheless it is shown to lead to very poor predictions of other observable quantities and more important, to contain striking internal inconsistencies. These are pointed out and discussed. The theory is interpreted in a way which shows how, as it has been applied, it is essentially invariant with respect to the internal inconsistency as well as to a demonstrably false assumption on which it is based. (Contractor's abstract)

2665

Rochester U. Inst. of Optics, N. Y.

RESEARCH ON FUNDAMENTALS OF GEOMETRICAL OPTICS, by R. E. Hopkins. Final rept. Oct. 31, 1962. 1v. incl. diagrs. tables, refs. (AFOSR-4624) (AF 49(638)668) AD 296404 Unclassified

A set of programs have been prepared to carry out many of the requirements for automatic lens design on a data processing machine. This set of programs is called ORDEALS. The ORDEALS programs are described as follows: optics programs for the computer, a general linearization method for automatic lens correction, and an introduction to the geometric optical frequency response.

2666

Rochester U. Inst. of Optics, N. Y.

A GENERAL LINEARIZATION METHOD FOR AUTOMATIC LENS CORRECTION, by G. H. Spencer. [1962] 18p. incl. refs. (Bound with its AFOSR-4624; AD 296404 as Appendix B)[AF 49(638)668] Unclassified

The use of programmed computing machinery for automatic lens correction requires a definite prescription according to which a lens system may be adjudged: (a) acceptable or not acceptable, or (b) improved or not improved over a previous configuration. Judgment of the first kind may be made on the basis of whether or not a given set of equations are satisfied; judgments of the second kind, on the basis of whether or not the value of a "merit function" has been reduced. A typical lens design problem will involve both absolute requirements, to which a judgment of the first kind is appropriate, and relative requirements calling for a judgment of the second kind. This paper describes a linearization method designed to accomodate requirements of both types. Several previously described linearization procedures are shown to be included within the framework of the present method. (Contractor's abstract)

2667

Rochester U. Inst. of Optics, N. Y.

EMISSION SPECTRA OF KCl: Tl, KBr: Tl, AND KI: Tl AT 300, 80, AND 12°K, by R. Edgerton and K. Teegarden. [1962] [6]p. incl. diagrs. (AFOSR-65-0405) (AF AFOSR-63-236) Unclassified

Also published in Phys. Rev., v. 129: 169-174, Jan. 1, 1963.

Emission spectra have been measured for single crystals of KCl, KBr, and KI doped with about 0.01 mol % thallium. The measurements were made at 300, 80, and

12°K. Several new bands observed at 12°K are reported. An emission band which is centered directly on the A-absorption band is shown to be present in KI:Tl and KBr:Tl as well as KCl:Tl. An energy level scheme is suggested to explain the observed emission.

2668

Rockford Research Inst., Inc., Cambridge, Mass.

A FORMAL THEORY OF INDUCTIVE INFERENCE. PART I, by R. J. Solomonoff. [1962] [22]p. (AFOSR-64-0946) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-377 and Public Health Service) AD 440057 Unclassified

Presented at Conf. on Cerebral Systems and Computers, California Inst. of Tech., Pasadena, Feb. 8-11, 1960.

Also published in Inform. and Control, v. 7: 1-22, Mar. 1964.

Four ostensibly different theoretical models of induction are presented, in which the problem dealt with is the extrapolation of a very long sequence of symbols—presumably containing all of the information to be used in the induction. One of these models is equivalent to a Bayes formulation, in which a priori probabilities are assigned to sequences of symbols on the basis of the lengths of inputs to a universal Turing machine that are required to produce the sequence of interest as output. Few rigorous results are presented. Informal investigations are made of the properties of these models. There are discussions of their consistency and meaninfulness, of their degree of independence of exact nature of the Turing machine used, and of the accuracy of their predictions in comparison to those of other induction methods.

2669

Rockford Research Inst., Inc., Cambridge, Mass.

A FORMAL THEORY OF INDUCTIVE INFERENCE. PART II. by R. J. Solomonoff. [1962] [31]p. (AFOSR-64-1388) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-377 and Public Health Service) AD 444470 Unclassified

Also published in Inform. and Control, v. 7: 224-254, June 1964.

Induction systems introduced in item no. 2668, Vol. VI are applied to 3 specific types of problems and the reasonableness of the results obtained is discussed. The first section deals with the Bernoulii sequence. The predictions obtained are identical to those given by Laplace's rule of succession. The next section deals with the extrapolation of a sequence in which there are certain kinds of intersymbol constraints. Codes for such sequences are devised and some properties of the coding method are discussed. The use of phrase structure grammars for induction is described in the third section. The last section considers the use of the induction theory for decision making.

2670

Rome U. [Dept. of Pharmacology] (Italy).

NEUROPHYSIOLOGICAL STUDIES OF BEHAVIOR (MODIFICATIONS OF CORTICAL EVOKED RESPONSES DURING AVOIDANCE CONDITIONING IN THE MONKEY). by G. Ricci. Mar. 1, 1962, 27p. incl. illus. refs. (AFOSR-2510) (AF 61(052)345) AD 289849 Unclassified

Experiments were carried out in order to investigate the modifications of the following cortical evoked responses during avoidance conditioning experiments as well as during spontaneous EEG arousel in the monkey: (1) cortical responses evoked by single electrical stimuli to specific thalamic nuclei in the sensory-motor, frontal and visual areas, (2) cortical responses evoked in the sensory-motor cortex by peripheral stimuli (single shocks to the hand), and (3) cortical responses evoked by repetitive thalamic stimulation (augmenting responses) to the specific thalamic nuclei in the sensory-motor and visual areas.

2671

Rome U. School of Aeronautical Engineering (Italy).

SUMMARY REPORT OF SOME RESULTS ON RE-ENTRY PROBLEMS, by L. Broglio. Jan. 1962 [21]p. incl. diagrs. (Technical rept. no. 2; SIARgraph no. 62) (AFOSR-2749) (AF 61(052) 198) AD 281211 Unclassified

A general theoretical analysis of re-entry trajectories, guidance problems, and heat conduction is presented. The modeling technique developed previously (item no. 2585, Vol. V) was extended to higher Mach numbers, and higher stagnation temperatures than attained in the earlier tests. This technique has been applied to find the laminar heat transfer rates on a blunt body consisting of a 20° cone with hemispherical nose. Suggestions for future research are also given.

2672

Rome U. School of Aeronautical Engineering (Italy).

HEAT CONDUCTION IN BLUNT-SHAPED BODIES. by L. Broglio. Sept. 1962 [20]p. incl. diagrs. (Technical note no. 6; SIARgraph no. 64) (AFOSR-4359) (AF 61(052)198) AD 394636 Unclassified

Research is described of eigenvalues and eigenfunctions to be used in connection with thermal problems, for the case of general elliptic coordinates. Two

particular cases, spherical shells and parabolic shells, are studied. The reduction to ordinary equations and a method of solution for thin shells are also presented. (Contractor's abstract)

2673

Rome U. School of Aeronautical Engineering (Italy).

RADIATION WITH TEMPERATURE DEPENDENT THERMAL PROPERTIES, by L. Broglio. Apr. 1962. iv. incl. diagrs. (Technical note no. 7; SIARgraph no. 65) (AFOSR-4369) (AF 61(052)198) AD 294986 Unclassified

The problem of radiation from a generic body with variable thermal coefficients is considered and a general equation of Volterra's type is derived. Explicit expression is also given for the spherical shell; whence the solid sphere, the flat plate, and the indefinite body can be studied. Also, a practical solution for numerical application is devised. In part II the theory is applied to particular laws of variation of thermal coefficients, and the effect of such coefficients is investigated. (Contractor's abstract)

2674

Royal Coll. of Science and Tech. Dept. of Chemistry, Glasgow (Scotland).

PREPARATION AND STUDY OF PROPERTIES OF FERROCENE DERIVATIVES, by P. L. Pauson, W. E. Watts, and J. Cleveland. Final technical rept. Dec. 31, 1962, iv. incl. diagrs. tables, refs. (AFOSR-4582) (AF 61(052)321) AD 400100 Unclassified

Routes are described, leading to novel ferrocences, especially diferrocenyl-methane, -ethane, -ethylene and -acetylene, triferrocenylmethane, and related compounds, ferrocence derivatives containing Ni, Co and Mn, as well as ferrocenyl groups.

2675

Royal Coll. of Science and Tech. [Dept. of Chemistry] Glasgow (Scotland).

FERROCENCE DERIVATIVES. PART XII. DI- AND TRIFERROCENYLMETHANE DERIVATIVES, by P. L. Pauson and W. E. Watts. [1962] [7]p. incl. refs. [AF 61(052)321] Unclassified

Published in Jour. Chem. Soc. (London), No. 764: 3880-3886, Oct. 1962.

Diferrocenylmethane is obtained from ferrocence and paraformaldehyde. Its conversion via diferrocenyl ketone into a series of diferrocenylalkanols is described. α,α-Diferrocenylbenzyl alcohol can also be obtained by condensation between ferrocence and benzoylferrocence. Two routes to triferrocenylmethane and to 1, 1'-di(ferrocenylmethyl)ferrocene, a new method for preparing ferrocenecarboxyaldehyde, and the aldol condensation of acetylferrocence are reported. (Contractor's abstract)

2676

Royal Coll. of Science and Tech. Dept. of Chemistry, Glasgow (Scotland).

FERROCENE DERIVATIVES. PART XIII. SOME FERROCENYLETHYLENE AND -ACETYLENE DERIVATIVES, by P. L. Pauson and W. E. Watts. [1962] [21]p. incl. refs. (Bound with its AFOSR-4582; AD 400100) (AF 61(052)321) Unclassified

Published in Jour. Chem. Soc. (London), No. 552: 2990-2996, May 1963.

Ferrocenecarboxyaldehyde and benzoylferrocene have been converted to 1, 2-diferrocenylethylene derivatives, and (ferrocenylmethylene)-triphenylphosphorane has been used for the preparation of a range of related olefins and acetylenes. (Contractor's abstract)

2677

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

MAGNETO-GAS-DYNAMIC SHOCK WAVES IN A GAS WITH VARIABLE CONDUCTIVITY, by J. B. Helliwell and D. C. Pack. [1962] [3]p. (AFOSR-3781) (AF EOAR-61-49) Unclassified

Also published in Phys. Fluids, v. 5: 738-740, June 1962.

Basic equations for shock waves in a magnetized gas of variable conductivity are given. These equations relate the parameters of the gas on the 2 sides of the shock front.

2678

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

GAS-IONIZING SHOCK AND COMBUSTION WAVES IN MAGNETOGASDYNAMICS, by J. B. Helliwell. [1962] [15]p. incl. diagrs. (AFOSR-3513) [AF EOAR-61-49] Unclassified

Also published in Jour. Fluid Mech., v. 14: 405-419, Nov. 1962.

Some general properties of 1-dimensional deflagration waves in a non-conducting inviscid gas at rest are discussed when ionization of the gas takes place across a shock wave which precedes the flame front, and electromagnetic fields are present. The direction of wave propagation, the electric field and magnetic field are taken as a mutually orthogonal triad of vectors.

The jump relationships across the gas-ionizing shock wave and magnetogasdynamic combustion wave are investigated and the 2 Hugoniot curves analyzed in detail in the pressure-specific volume plane. The possible types of wave are indicated for arbitrary magnitudes of the unstream electromagnetic field. It is shown that weak gas-ionizing shock waves cannot exist. For suitably chosen electromagnetic field strengths the density ratio across the shock wave may be greater than the ordinary gasdynamic limit and, in such cases, the pressure and density ratios are related in an inverse manner, in contrast to the behavior for ordinary gasdynamic or magnetogasdynamic shock waves. The magnetogasdynamic combustion wave has similar properties to that in ordinary gasdynamics (Contractor's abstract)

2679

Royal Coll. of Science and Tech. Dept. of Mathematics. Glasgow (Scotland).

MAGNETOGASDYNAMIC DEFLAGRATION AND DETONATION WAVES WITH IONIZATION, by J. B. Helliwell. [1962] [19]p. incl. diagrs. (AFOSR-3927) (AF EOAR-63-22) AD 416527 Unclassified

Also published in Jour. Fluid Mech. v. 16: 243-261, June 1963.

The propagation of a one-dimensional combustion wave into a non-ionized gas at rest in the presence of an electromagnetic field is considered when ionization of the gas occurs across either the combustion wave or a preceding shock wave. The electric and magnetic fields in the undisturbed gas ahead of the waves are mutually perpendicular and orthogonal to the direction of wave propagation. It is shown that steady detonation occurs at a point which is analogous to the Chapman-Jouguet point of ordinary gas-dynamic combustion theory. Numerical calculations are made of the state of the gas between and behind the waves in 3 particular models, in both of which the upstream electric field is zero. The models are then equivalent to magnetogasdynamic phenomena in a perfectly conducting gas. First, the case of steady detonation is studied. Secondly, steady deflagration in a tube, closed at one end, is discussed. (Contractor's abstract)

2680

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

HYDROLYSIS EQUILIBRIA OF CATIONS AND ANIONS, by L. G. Sillén. Final technical rept. Oct. 1, 1958-Sept. 20, 1962. Oct. 6, 1952, 21p. incl. refs. (AFOSR-3766) (AF 61(052)162) AD 289352 Unclassified

This report on hydrolysis equilibria of cations and anions summarizes 26 technical notes that have been published as articles in scientific journals, and in addition 25 future papers that have been practically completed. Crystal structure analyses on oxo- and hydroxo-compounds of Cr, Fe, Al, In, Ge, Te, Zr, Th, V, Co, Ni, Zn, Ga, Sn and Pb were achieved. The existence of discrete groups $Al_2(OH)_2(H_2O)_8^{4+}$ and $Al_{13}O_4(OH)_{24}(H_{20})_6^{7+}$ was proved and their structures determined. For compounds of Ge, Sn and Pb, illustrations for the solution equilibria were found. The treatment of data in complicated systems was greatly aided by a generalized least-squares program for high-speed computers. For thermochemical studies, an automatic recording calorimeter for enthalpy titrations was constructed, and a special general least-squares program worked out. Results are given for the $Br^- - Hg^{2+}$ system but data on many more systems are available. (Contractor's abstract)

2681

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE STRUCTURE OF CrOCl, by H.-E. Forsberg. [1962] [1]p. incl. diagrs. [Technical note no. 23] (AFOSR-3778) (AF 61(052) 152) Unclassified

Also published in Acta Chem. Scand., v. 16: 777, 1962.

From rotation and Weissenberg photographs taken around the b-axis with CuK radiation, it was found that the crystals are orthorhombic with a =3.68 b =3.20, and c = 7.78Å. The following preliminary parameters of the atoms were determined from Patterson and Fourier projections on the xz plane and geometrical considerations: 2 Cr in 2(a) ± (1/4, 1/4, z) with z = 0.109, 2 Cl in 2(b) ± (1/4, 3/4, z) with z = 0.327; and 2 O in 2(b) ± (1/4, 3/4, x) with z = 0.96.

The ranges of interatomic distances were: Cr-Cr, 3.04; Cr-O, 1.97-2.01; Cr-Cl, 2.32; O-O, 2.51; O-Cl, 2.93-3.35; and Cl-Cl, 3.20-3.86Å.

2682

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden)

STUDIES ON THE HYDROLYSIS OF METAL IONS. 40. A LIQUID DISTRIBUTION STUDY OF THE HYDROLYSIS OF Cd^{2+}, by D. Dyrssen and P. Lumme. [1962] [9]p. incl. diagrs. refs. (AFOSR-3751) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Finnish State Commission for Natural Sciences) AD 414031 Unclassified

Also published in Acta Chem. Scand., v. 16: 1785-1793, 1962

The distribution of cadmium at 25°C between the liquid amine LA-1 in benzene and 3 M Na(ClO4, OH) has been measured, as a function of $[OH^-]$, with radioactive cadmium. The distribution data could be explained by Dyrssen and Silien's 2-parameter approximation for the stepwise formation of $Cd(OH)_4^{2-}$ from Cd^{2+}. High-speed refinement of the parameters obtained by curve-fitting gave the following values with the σ-deviations:

$$a = 1/4 \log \beta_4 = 3.012 \pm .043$$

$$b = 1.2 \log K_n K_{n+1}^{-1} = 0.429 \pm 0.047$$

$$\log \nu_2 \beta_2 (20\%\ LA\text{-}1) = 16.345 \pm 0.082$$

The value for the formation constant of $Cd(OH)^+$, $\log K_1 = 4.30 \pm 0.18$, agrees very well with the value in 3 M $LiClO_4$ determined by Biedermann and Ciavatta. Some experiments were also carried out with radioactive $Cd(OH)_2$ in a solubility column, but the solubility is lower than that predicted from the values of a and b and Schindler's value of the solubility product of $Cd(OH)_2$ in 3 M $NaClO_4$.

2683

Royal Inst. of Tech. Dept. of Inorganic Chemistry, (Stockholm (Sweden).

THE CRYSTAL STRUCTURE OF $Na_4Ge_9O_{20}$, by N. Ingri and G. Lundgren. [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-64-1049) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Swedish Natural Science Research Council) AD 441490 Unclassified

Also published in Acta Chem. Scand., v. 17: 617-633, 1962.

Crystals of $Na_4Ge_9O_{20}$ are tetragonal, space group $I4_1$ a, with the dimensions a = 14.98 ± 0.01 A, c = 7.384 ± 0.005 A. The unit cell contains 4 formula units. Using 3-dimensional Patterson and Fourier methods the germanium, oxygen and sodium positions have been determined. These positions have been refined using the method of least squares. The refined atomic coordinates are collected in tabular form.

$Na_4Ge_9O_{20}$ is built up of GeO_4 tetrahedra and GeO_6 octahedra coupled together forming a 3-dimensional network. The Ge-O distances have been determined with a standard deviation of ± 0.015 A. The most important distances and angles in the structure are tabulated. The mean Ge-O distance for octahedral coordination is 1.90_7 A (in the structure varying from 1.82_2 A to 1.99_8 A) and for tetrahedral coordination 1.74_0 A (in the structure varying from 1.71_5 to 1.76_4 A).

(Contractor's abstract)

2684

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE DETERMINATION OF THE FORMATION CONSTANT OF $GeO_2(OH)_2^{2-}$ USING A HYDROGEN-ELECTRODE. MEASUREMENTS IN 3 M Na(Cl)-MEDIUM, by N. Ingri and G. Schorsch. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-64-1555) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Swedish Natural Science Research Council) AD 446139 Unclassified

Also published in Acta Chem. Scand., v. 17: 590-596, 1963.

The formation constant of $GeO_2(OH)_2^{2-}$ at 25°C in a 3 M NaCl medium has been determined using a hydrogen electrode. The following reactions and constants were obtained:

$$GeO(OH)_3^- + OH^- \rightleftharpoons GeO_2(OH)_2^{2-} \quad \log K_2 = 1.64 \pm 0.03$$

$$GeO(OH)_3^- \rightleftharpoons GeO_2(OH)_2^{2-} + H^+ \quad \log {}^*K_2 = -12.43 \pm 0.03 \quad (\log K_w = -14.07)$$

In the range studied there were no indications of the formation of polyanions. (Contractor's abstract)

2685

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE ION ACTIVITY FUNCTION—AN APPROACH TO THE STUDY OF ELECTROLYTE BEHAVIOR IN CONCENTRATED SOLUTIONS. I. THE SYSTEMS LiCl-H_2O AND LiBR-H_2O, by E. Hogfeldt and L. Leifer. [1962] [7]p. incl. diagrs. table. (AFOSR-65-1249) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162, Atomic Energy Commission, and Swedish Atomic Energy Research Council) AD 619756 Unclassified

Also published in Acta Chem. Scand., v. 17: 338-344, 1963.

An approach to behavior in concentrated electrolytes is presented. Utilizing the fact that a unique ion activity function was obtained for H_3O^+ in several strong acids, ion activity and ion activity coefficient functions for the ions in the systems LiCl-H_2O and LiBr-H_2O over a wide

composition range have been calculated. The results indicate that free Li^+ carries about three water molecules even in the most concentrated solutions and Cl^- and Br^- are unhydrated in the region 12m to saturation. The decrease in $\pi_0^{-1} y_{Cl^-}$ and $\pi_0^{-1} y_{Br^-}$ (seen in the highest concentrations of the salt solutions) has been interpreted as due to ion-pair formation. It is assumed that the ion activity coefficient function of Cl^- and Br^- would be constant in the high salt concentration if no ion-pairing occurred and based on deviations approximate values for the degree of dissociation, α, of the ion pair can be calculated.

2686

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

EQUILIBRIUM STUDIES OF POLYANIONS. 10. ON THE FIRST EQUILIBRIUM STEPS IN THE ACIDIFICATION OF $B(OH)_4^-$, AN APPLICATION OF THE SELF-MEDIUM METHOD, by N. Ingri. [1962] [8]p. incl. diagrs. tables. ([Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162] and Swedish Natural Science Research Council) Unclassified

Published in Acta Chem. Scand., v. 17: 573-580, 1963.

In the present work the "self-medium" method has been used to study the reactions, $qB(OH)_4^- + pH_2O \rightleftharpoons H_p(B(OH)_4)_q^{-q+p} + pOH^-$. The acidification was followed to $Z = 0.05$ for $B = 3.0, 2.5, 2.4, 1.2$ and 0.6 M. Z is the average number of H^+ bound to $B(OH)_4^-$ assuming no hydrolysis and B the total borate concentration. In the range over which it was studied, Z is mainly determined by p. The data indicated for $B = 2.5$ M, main species with $p = 2$ ($B_3O_3(OH)_4^-$ or $B_4O_5(OH)_4^{2-}$ or $B_5O_6(OH)_6^{3-}$ etc) and for $B \leq 1.2$ M, additional species with $p = 1$ ($B(OH)_3$ or $B_2O(OH)_5^-$ or $B_3O_3(OH)_5^{2-}$ etc). The data have been explained on the basis of the formation of the complexes $B(OH)_3$, $B_4O_5(OH)_4^{2-}$ and $B_3O_3(OH)_5^{2-}$ and the following equilibrium constants have been deduced: $\log K_1 = -5.31 \pm 0.02$, $\log K_{24} = -7.34 \pm 0.11$ and $\log K_{13} = -4.64 \pm 0.19$. The constants have been refined using the least squares program LETAGROP and the errors given are 3σ (σ is the standard deviation). (Contractor's abstract)

2687

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

EQUILIBRIUM STUDIES OF POLYANIONS. 11. POLYBORATES IN 3.0 M Na(Br), 3.0 M Li(Br) AND 3.0 M K(Br), A COMPARISON WITH DATA OBTAINED IN 3.0 M $Na(ClO_4)$, by N. Ingri. [1962] [9]p. incl. diagr. table. ([Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162] and Swedish Natural Science Research Council) Unclassified

Published in Acta Chem. Scand., v. 17: 581-589, 1963.

Using a hydrogen electrode, the borate equilibria have been studied at 25°C in the three media, 3.0 M Na(Br), 3.0 M Li(Br), and 3.0 M K(Br). The total boron concentration, B, has been varied, usually between 0.01 and 0.400 M. These data as well as the data we obtained earlier for 3.0 M $Na(ClO_4)$ medium could be explained by the species, $B(OH)_3$, $B(OH)_4^-$, $B_4O_5(OH)_4^{2-}$ and small amounts of $B_5O_6(OH)_4^-$. However, for 3.0 M $Na(ClO_4)$, 3.0 M Na(Br) and 3.0 M Li(Br), the data are slightly better explained by assuming that $B_3O_3(OH)_5^{2-}$ is also formed. There is no evidence for formation of $B_3O_3(OH)_5^{2-}$ in 3.0 M K(Br). Equilibrium constants and standard deviations have been calculated for these combinations using the computer program LETAGROP; the results of the calculations are tabulated. (Contractor's abstract)

2688

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

EQUILIBRIUM STUDIES OF POLYANIONS. 12. POLYGERMANATES IN Na(Cl) MEDIUM, by N. Ingri. [1962] [20]p. incl. diagrs. tables, refs. ([Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162] and Swedish Natural Science Research Council) Unclassified

Published in Acta Chem. Scand., v. 17: 597-616, 1963.

The pH equilibria of germanic acid and germanate ion have been studied in 0.5 m (molality) Na(Cl) medium at 25°C by electrometric titration using a glass or a hydrogen electrode. The total germanium concentration, B, had values generally between 0.0005 and 0.040 m. When the total germanium concentration B is $\leq$ 0.005 m, essentially only the mononuclear species germanic acid $Ge(OH)_4$ and the ions $GeO(OH)_3^-$ and $GeO_2(OH)_2^{2-}$ seem to be present; the data for $B > 0.005$ m give evidence also for a polynuclear species containing

eight germanium atoms and with a charge minus three. The following reactions and constants were obtained:

$Ge(OH)_4 + OH^- = GeO(OH)_3^-$ $\log \beta_1 = 4.67_8 \pm 0.006$

$Ge(OH)_4 + 2OH^- = GeO_2(OH)_2^{2-}$ $\log \beta_2 = 6.14 \pm 0.13$

$8Ge(OH)_4 + 3OH^- = (Ge(OH)_4)_8(OH)_3^{3-}$ $\log \beta_{38} = 29.14 \pm 0.05$ $H_2O \rightleftharpoons H^+ + OH^-$ $\log K_w = -13.70 \pm 0.03$

The constants have been refined using the least squares program LETAGROP and the error given is 3σ (σ is the standard deviation). (Contractor's abstract)

2689

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden)

STUDIES ON THE HYDROLYSIS OF METAL IONS PART 41. THE HYDROLYSIS OF THE CADMIUM ION, Cd^{2+}, by G. Biedermann and L. Ciavatta. [1962] [19]p. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Swedish National Science Research Council) Unclassified

Published in Acta Chem. Scand., v. 16: 2221-2239, 1962.

The hydrolysis equilibria of the Cd(II) ion have been studied at 25°C by measuring the hydrogen ion concentration of a series of cadmium perchlorate solutions using a glass or a quinhydrone half-cell. The $[Cd(II)]_{tot}$ has ranged from 0.1 to 1.45 M. For each $[Cd(II)]_{tot}$ the $[H^+]$ was increased from a value corresponding to a solution saturated with $Cd(OH)_2$, until hydrolysis became negligible. All solutions studied were made to contain 3 M ClO_4^- by adding $LiClO_4$. The emf data, which show that only a small part of the Cd^{2+} ions can be transformed to hydrolysis products without precipitation, may be explained by assuming the equilibria

$Cd^{2+} + H_2O = CdOH^+ + H^+$ $\log *_{1,1} = -10.2 \pm 0.1$ (1)

$2\,Cd^{2+} + H_2O = Cd_2OH^{3+} + H^+$ $\log \beta_{1,2} = 9.10 \pm 0.05$ (2)

$4\,Cd^{2+} + 4H_2O = Cd_2(OH)_4^{4+} + 4H^+$ $\log \beta_{4,4} = -31.8 \pm 0.1$ (3) It may be deduced on the basis of the equilibrium constants (1), (2) and (3) that for $[Cd(II)]_{tot} > 0.1$ M the principal product of hydrolysis is the species Cd_2OH^{3+}.

2690

Rutgers U. Coll. of Engineering, New Brunswick, N.J.

FATIGUE STUDIES OF METAL CRYSTALS, by A. Shrier, P. Wallace and others. [1962] [11]p. incl. illus. diagrs. tables, refs. (AFOSR-J885) (AF 49(638)17) AD 293471 Unclassified

Also published in Acta Metall., v. 11: 779-789, July 1961.

Single crystals of silver and zinc were fatigued in alternating bending at constant strain amplitude of 0.12% and 0.2% for silver and 0.01% for zinc. They were studied by a combination of several x-ray techniques (double-crystal diffractometer, divergent beam, x-ray reflection microscopy), electron transmission microscopy and hardness measurements. The experimental results indicate that the fatigue process may be divided into 3 stages. The initial stage can be identified with cyclic work-hardening and is attributed to a general increase in dislocation density. The second stage represents a period of dynamical recovery. It consists in the removal of dislocations from distorted lattice domains and leads to a decrease of coarse lattice misalignments. At this stage cross-slip seems to play a fundamental role, as a process by which dislocations can escape from their locked positions. When cross-slip was obstructed by a high-angle boundary in silver or a twin boundary in zinc a premature fatigue failure occurred at the obstruction. The third stage is characterized by an extensive fragmentation of the structure. Due to the interaction of basal and pyramidal slip in zinc the structure resulting from this process shows considerable differences compared to that of silver. It appears that the high-stress fatigue process (below yield stress) is in principle not different from the low-stress fatigue mechanism except for a higher rate. It is believed that fatigue failure may perhaps result from the obstructions to cross-slip by internal barriers consisting of lattice domains of high dislocation density, the latter being formed by dynamical recovery. (Contractor's abstract)

2691

Rutgers U. [Dept. of Physics] New Brunswick, N. J.

CHANGES IN NUCLEAR SPIN RELAXATION BY IRRADIATION OF ELECTRON RESONANCES (Abstract), by G. E. Schacher and H. C. Torrey. [1962] [1]p. [AF 49(638)755] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 85, Jan. 24, 1962.

Proton spin relaxation time T_{1N} in several solid insulators in which proton and electron spins are coupled by dipolar interaction has been measured. In such materials, positive and negative enhancements of proton polarization are produced by saturating double flip transitions. It has been found that T_{1N} is less than normal when double flips are induced by applied rf and that T_{1N} is greater than normal, sometimes by two orders of magnitude, when the central

electron resonance is strongly excited. The first effect is understandable from the normal rate equations. The second can be explained by a decoupling of electrons and proton spins due to the stirring of the electron spins by the applied rf.

2692

Rutgers U. [Dept. of Physics] New Brunswick, N. J.

NUCLEAR MAGNETIC RESONANCE OF Xe^{129} (Abstract), by E. R. Hunt and H. Y. Carr. [1962] [1]p. [AF 49(638)755] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 293, Apr. 23, 1962.

The Xe^{129} relaxation time in gaseous and liquid xenon has been measured using new samples whose impurity content is lower than that used by Streever and Carr (item no. 2443, Vol. IV). In contrast to the previous results, the relaxation rate is proportional to the density of the gas: $1/T_1 = 5.7 \times 10^{-6} \rho$ (ρ in amagats). A similar result has been observed independently by Staub and co-workers. In the liquid in equilibrium with its vapor, $T_1 = 1000$ sec; no temperature dependence was found within the experimental error of 15% for the new samples in the range 0° to -74°C. In both the liquid and gas, the shift in the resonant field is proportional to the density and the field: $\Delta H = 4.3 \times 10^{-7} \rho H_0$. Diffusion measurements indicate that $D = 6 \pm 1 \times 10^{-4}$ cm^2/sec at 235 amagats in the gas and $1.6 \pm 0.3 \times 10^{-4}$ cm^2/sec in the liquid at -74°C.

2693

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

A COMPARATIVE STUDY OF THREE SYSTEMS OF INFORMATION RETRIEVAL: A SUMMARY, by N. D. Stevens. [1961] [4]p. (AFOSR-3516) (AF 49(638)948) AD 621408 Unclassified

Also published in Amer. Doc., v. 12: 243-246, Oct. 1961.

For abstract see item no. 2610, Vol. V.

2964

Rutgers U. [Graduate School of Library Service] New Brunswick, N. J.

COOPERATIVE STORAGE WAREHOUSES, by H. J. Harrar. Doctoral thesis, May 1962, 203p. incl. tables, refs. (AFOSR-2615) (AF 49(638)849) AD 278712 Unclassified

Summary published in Coll. and Research Libraries, v. 25: 37-43, Jan. 1964.

Cooperative storage warehouses have been suggested as a possible means by which large libraries may, with minimal expenditures, retain and even acquire infrequently used but potentially valuable research material. Three types of this facility exist in the United States today. The first, exemplified by the New England Deposit Library, is a central storage warehouse owned and operated by several participating libraries. Each member merely rents space in a jointly-owned building, determines how its space is to be used, and maintains its own collections. The second type, illustrated by the Hampshire Inter-Library Center, is a consolidated warehouse owned and supported by a group of cooperating libraries. Each member contributes its little-used serials to the warehouse, which completely integrates the resulting collection. Contributed funds and income from the disposition of duplicates provide for a limited acquisitions program of rarely-consulted serials and expensive sets. The third type, illustrated by the Midwest Inter-Library Center, is distinguished from the preceding 2 types by the scope of its operations and holdings. Materials deposited by members are absorbed into the collections when deposit limitations permit, and duplicates are discarded. Unlike the others, this type has a professional staff which operates library programs approved by the membership and which carries on an acquisitions program designed to supplement members collections as well as to strengthen library resources in the region. The present study determines the effectiveness of each of these types of warehouses and recommends optimum measures for storage of little-used materials.

2695

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

THE FUNCTION OF A MODERN SPECIAL LIBRARY, by R. R. Shaw. [1962] [8]p. (AFOSR-3828) (AF AFOSR-62-9) AD 416512 Unclassified

Also published in Research Management, v. 5: 485-492, Nov. 1962.

The special library differs from the general library in that it can design the scope of its collections and services to support defined objectives of the group it serves, and by concentrating on the needs and problems of that group, it can provide service of much greater depth and quality than can be provided by the general library. The intellectual requirements require that any and all material in the universe, treated in the special library, be focussed on the problems and needs

of the community which the library serves. This may mean preparation of new abstracts from the special point of view of the company, it may mean translation and other conversion of materials to meet local needs. It might be best done by running a messenger service to another library. It might require computer time. If the intelligence has to be evaluated by people with subject competence, provision should be made for use of substantive staff. All of this should be done without wasting the time of the bench scientist on bibliographical operations which can be performed better, faster, and cheaper by trained bibliographers. The special library should be operated as a dynamic service rather than as a storage warehouse.

2696

Saarlandes U. Saarbrücken (Germany).

EFFECTS OF ANXIETY LEVEL AND MILD SITUATIONAL STRESS ON VARIOUS PSYCHOLOGICAL FUNCTIONS; THE INTERRELATIONSHIPS AMONG THESE FUNCTIONS ANXIETY LEVEL AND OTHER PERSONALITY VARIABLES; A MULTIVARIABLE AND FACTORIAL STUDY, by O. Spreen. Final rept. Aug. 1962, 158p. incl. tables, refs. (AFOSR-4283) (AF 61(052)-483) AD 292785 Unclassified

Fifty-eight variables selected from various psychological functions were studied. Two hundred ninety two German males were selected as representing the highest and lowest 30% on the anxiety scale (matched for intelligence). High and low anxiety groups were randomly assigned to conditions of mild situational stress and nonstress. For each variable, an individual statistical analysis was performed. Results were as follows: (1) Variables under investigation were not significantly influenced by stress and nonstress conditions of testing, (2) Fifteen out of 36 hypotheses about questionnaire data were confirmed, (3) Four significant specific factors, 7 significant "ability" factors, and 5 other significant factors were extracted. Results of the individual and factor analysis were discussed with respect to relevant literature concerning the general topics of study. Additional results concerning the variables under investigation were briefly discussed. (Contractor's abstract, modified)

2697

St. Bartholomew's Hospital. Dept. of Pharmacology, London (Gt. Brit.).

AN ESERINE-LIKE ACTION OF CHLORAL HYDRATE, by D. A. Brown. [1962] [9]p. incl. illus. (AFOSR-4194) (AF 61(052)25) AD 631886; AD 406820 Unclassified

Also published in Brit. Jour. Pharmacol. and Chemother., v. 19: 111-119, Aug. 1962.

The intra-arterial injection of chloral hydrate potentiated the transmission of nerve impulses through the cat superior cervical ganglion, antagonized the ganglion-blocking action of hexamethonium, and greatly enhanced the ganglion-stimulant action of acetylcholine. Effects on the ganglion-stimulant actions of carbachol, nicotine, tetramethylammonium and potassium chloride were slight or absent. Chloral hydrate itself usually had no direct stimulant action. The neuromuscular-blocking action of tubocurarine on the isolated rat diaphragm preparation was completely and rapidly reversed by chloral hydrate. This reversal was prevented by previous treatment of the muscle with neostigmine. Chloral hydrate potentiated the actions of acetylcholine and nicotine on the isolated rabbit duodenum, and, in concentrations exceeding 1 mg. ml, produced a spasm which was abolished by hyoscine but not by mepyramine. It was concluded that these eserine-like effects were manifestations of an anticholinesterase action of chloral hydrate. Neither chloralose nor trichlorethanol showed evidence of this property. (Contractor's abstract)

2698

St. John's U. [Dept. of Physics] Jamaica, N. Y.

[CALCULATIONS OF CROSS-SECTION IN ELECTRON COLLISION], by S. N. Milford. Final rept. [1962] [3]p. (AFOSR-3943) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-10 and Office of Naval Research) Unclassified

The properties of a hot gas or plasma depend on the populations of the various levels of the atoms and molecules present. The inelastic electron collisions of excited hydrogen atoms were considered because these change the relative populations of the levels in a nonequilibrium plasma. The cases of collisions of protons or hydrogen atoms were also included since they compete with electron collisions.

2699

St. John's U. [Dept. of Physics] Jamaica, N. Y.

INELASTIC COLLISIONS OF PROTONS AND HYDROGEN ATOMS WITH EXCITED HYDROGEN ATOMS (Abstract), by J. F. Carew, S. N. Milford. [1962] [1]p. [AF AFOSR-61-10] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 79, Jan. 24, 1962.

Born cross sections for collision of a proton with an excited hydrogen atom may be derived approximately from the Born cross sections for collision of an electron with an excited hydrogen atom. A comparison of the exact and approximate Born cross sections for the collisions $p + H(nl) \rightarrow p + H(n'l')$: $1s \rightarrow 2s$, $1s \rightarrow 2p$, $3s \rightarrow 4p$, shows that they agree down to energies near the Born maximum. Born proton cross sections are being calculated for many transitions in the range $n, n' = 1$ to 10. For the collisions $H(1s) + H(n,l) \rightarrow H(n',l') + H(n'',l'')$, the electron Born differential cross sections can be used to give the atom Born differential cross sections. A number of cases in the range $n, n', n'' = 1$ to 10 is being calculated.

2700

St. Louis U. [Dept. of Physics] Mo.

THEORETICAL STUDIES CONNECTED WITH THE SOLID STATE RASER, by W. A. Barker, M. Lal Narchal and others. Final technical rept. Mar 15, 1959-Mar. 15, 1962. Apr. 14, 1962 [63]p. incl. diagrs. tables, refs. (AFOSR-2558) (AF 49(638)612) AD 277218 Unclassified

This theoretical analysis demonstrates that low noise radio frequency amplifiers may be designed and constructed. These devices, called RASERS, are radio frequency masers. Inversion of the nuclear spin population distribution may be achieved by saturating an allowed or forbidden electron spin transition with

microwave power of the appropriate frequency. The redistribution of nuclear spin population takes place as a result of a number of factors among which are: (1) the relative magnitude of the nuclear Zeeman interaction and the hyperfine interaction, (2) the algebraic sign of the nuclear gyromagnetic ratio or the hyperfine coupling contrast, (3) the orientation and frequency of the "pumping" field or fields, and (4) the nature and relative magnitude of the relaxation mechanisms. Eight cases of negative enhancement are tabulated on the nuclear polarization chart. Other possibilities are discussed in this analysis in more complex cases.

2701

[St. Louis U. Dept. of Physics, Mo.]

THE GAIN BANDWIDTH PRODUCT OF THE RASER, by F. X. Haas. [1962] [9]p. incl. diagr. table. (Bound with its AFOSR-2558; AD 277218) [AF 49(638)612] Unclassified

In order that a comparison of the gain and bandwidth of a raser can be made with the corresponding quantities of a maser and other amplifiers, the gain and bandwidth of the raser will be determined in terms of the Q's (quality factors) of the system modes. The values of the Q's determine whether or not stable power gain is possible. The bandwidth, $B = 2\Delta f$, of the raser is defined as the frequency width between points at which the magnitude of the reflection coefficient squared is reduced to half of its value at resonance. Thus the gain bandwidth product in the high gain limit for a solid state raser depends not only on the resonant frequency and the magnetic quality factor, but also on the resonant line width of the raser material. The best gain bandwidth product is obtained when both the bandwidth of the resonance line and the bandwidth of the coupling circuit are large.

2702

St. Louis U. [Dept. of Physics] Mo.

GAIN-BANDWIDTH OF A RASER (Abstract), by F. X. Haas and W. A. Barker. [1962] [1]p. [AF 49(638)612] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-25, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 553-554, Nov. 23, 1962.

Radio-frequency quantum-mechanical devices may be constructed using the interaction between nuclear and electron spins. The gain-bandwidth product of the raser has been calculated by analyzing an appropriate equivalent circuit. The analysis follows Strandberg's treatment of paramagnetic amplifiers. The result $G^{1/2}B = 2/[(1/B_m) + (|Q_{m0}|/f_0)]$ is valid in the high-gain limit for rasers and masers. In rasers, the signal frequency f_0 is due to nuclear magnetic resonance. The resulting natural linewidth B_m is often so narrow that $G^{1/2}B \gtrsim 2B_m$. In masers, $G^{1/2}B \cong (2f_0)|Q_{m0}|$. We estimate $G^{1/2}B$ to lie between 10 and 10^3 cps in Be^9, Si^{29}, and Ge^{73}. The magnetic-quality factor Q_{m0}, and B_m depend on the concentration of paramagnetic electrons.

2703

St. Louis U. [Dept. of Physics] Mo.

NEGATIVE ENHANCEMENT OF THE NUCLEAR MAGNETIC RESONANCE FOR I = 1/2 BY DYNAMIC NUCLEAR POLARIZATION (Abstract), by W. A. Barker and M. Lal Narchal. [1962] [1]p. [AF 49(638)612] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 293, Apr. 23, 1962.

It has been suggested that an inverted nuclear population distribution can be used to construct a low-noise quantum-mechanical amplifier operating in the range from 20 kc to 1000 mc. In an electron nuclear-coupled spin system for I = 1/2, it is quite easy to see the conditions for which the enhancement of the NMR is negative. A total of 24 cases of dynamic nuclear polarization have been investigated. Eight of these are favorable for raser action, of which 6 are a consequence of the Overhauser effect and 2 a consequence of the Jeffries-Abragam effect.

2704

St. Louis U. Dept. of Physics, Mo.

OVERHAUSER AND JEFFRIES-ABRAGAM EFFECT IN A FOUR-LEVEL SYSTEM, by M. Lal Narchal and W. A. Barker. [1962] [6]p. incl. diagr. tables. [AF 49(638)-612] Unclassified

Published in Appl. Opt., v. 2: 787-792, Aug. 1963.

The method of partial distributions is used to compute the normalized population distribution in an electron-nuclear coupled spin system in which I = S = 1/2. The expressions obtained are more general than those reported previously in that they include the effects of competitive relaxation and competitive radiative induced transition probabilities. It is clear that positive and negative enhancement may be obtained either by the Overhauser or the Jeffries-Abragam effect irrespective of the relative magnitudes of the nuclear Zeeman and hyperfine interaction energies. A small enhancement is not necessarily due to incomplete saturation, but may well be the result of compensating emission and absorption.

2705

St. Louis U. [Dept. of Physics] Mo.

POPULATION-DISTRIBUTION PROBLEM IN MANY-LEVEL ELECTRON-NUCLEUS-COUPLED SPIN SYSTEMS (Abstract), by M. Lal Narchal and W. A. Barker. [1962] [1]p. [AF 49(638)612] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 293, Apr. 23, 1962.

The method of partial distributions has been applied to calculate explicit population-distribution expressions for an electron-nucleus-coupled spin system (S = 1/2) when microwave pumps which saturate the allowed or first-order forbidden transitions are applied. The expressions show the possibility of obtaining positive or negative enhancement of the NMR signal for any nucleus of nonzero spin. Explicit enhancement expressions have been evaluated exhibiting features not evident in the I = 1/2 system.

2706

[St. Louis U. Dept. of Physics, Mo.]

RASER NOISE, by M. Lal Narchal. [1962] [5]p. incl. diagr. (Bound with its AFOSR-2558; AD 277218) [AF 49(638)612] Unclassified

There are two main contributions to the RASER noise - intrinsic RASER noise and noise due to the associated circuitry. The intrinsic RASER noise is due to the spontaneous transitions from a higher energy state to a lower energy state. The radiation so emitted has the same frequency as the input signal but has no definite phase relationship with it. The noise to signal ratio due to the spontaneous emission is of the order of the ratio of the Einstein's spontaneous and induced emission coefficients $\frac{8\pi h\nu^3}{C^3}$. Since the frequency of the RASER $\lesssim$ 100 mc, this ratio $\sim 10^{-27}$. The noise due to associated circuitry can be described by applying the Nyquist-Johnson theorem to an equivalent circuit representing the RASER amplifier.

2707

San Andrés U. Laboratorio de Física Cósmica de Chacaltaya, La Paz (Bolivia).

GAMMA RAY ASTRONOMY, by I. Escobar, R. Schulczewski and others. [1962] [46]p. incl. illus. diagrs. refs. (AFOSR-4082) (AF 49(638)290) Unclassified

Presented at Fourth Interamerican Symposium on the Peaceful Application of Nuclear Energy, (Mexico), Apr. 9-13, 1962.

An analysis is made of the characteristics of cosmic radiation of high energy gamma type and its production in this and other galaxies by assuming certain parameters based on recently obtained results. A study is made of the number of particles of this kind that can indicate on a detector the possible forms of separating showers generated from gamma rays from those much more frequently produced by protons. A description of the equipment used is given. Some of the preliminary results obtained are presented.

2708

San Andrés U. Laboratoria de Física Cósmica [de Chacaltaya] La Paz (Bolivia).

STUDY OF TIME VARIATIONS AND SOLAR MODULATIONS, by I. Escobar. Final technical rept. Oct. 1962, 1v. incl. illus. diagrs. tables, refs. (AFOSR-5215) (AF AFOSR-60-13) AD 415367; AD 419521 Unclassified

Mechanism by which the sun controls the intensity of cosmic radiation sampled at the earth are the subject of this investigation. The work performed at this institute was divided into 2 parts. First, the continuous recording of various components of the cosmic ray intensity with a variety of instruments. Second, the analysis and interpretation of the results, generally devoted to the study of Forbush decreases. Data for this analysis was obtained from the instruments at Chacaltaya and supplemented with results from several other institutions. (Contractor's abstract)

2709

San Andrés U. Laboratorio de Física Cósmica [de Chacaltaya] La Paz (Bolivia).

DAY TO DAY MODULATION OF GALACTIC COSMIC RAYS BY SOLAR WIND, by H. S. Ahluwalia. [1962] [21]p. incl. diagrs. (AFOSR-64-0033) (AF AFOSR-62-395) Unclassified

Also published in Proc. Fifth Interamer. Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 1: paper no 9, Sept. 1962.

Hydrodynamic expansion of solar corona (solar wind) provides an effective mechanism for day to day modulation of galactic cosmic rays. On quiet days cosmic rays tend to be entrapped in the co-rotating solar spiral interplanetary magnetic field created by quiet day solar wind and their guiding centers move past the earth with a velocit, of several hundred km/sec. The associated relativistic effects produce quiet day solar diurnal variation of cosmic rays, the amplitude and the time of maximum of which are related to the solar wind velocity in a simple manner. The explosive heating of the corona following a solar flare results in a "blast wave". On enveloping the earth this blast wave gives rise to cosmic ray storm and storm time diurnal variation. Further it is suggested that "approaching" and "receding" blast wave gives rise to anisotropic increases in cosmic ray intensity which are sometimes observed during the pre-onset and recovery phrases of cosmic ray storms. (Contractor's abstract)

2710

San Andrés U. Laboratorio de Física Cósmica [de Chacaltaya] La Paz (Bolivia).

ON SHORT-LIVED ANISOTROPIC COSMIC RAY INCREASE OF JULY 18, 1959 (Abstract), by H. S. Ahluwalia. [1962] [1]p. (AFOSR-64-0034) (AF AFOSR-62-395) Unclassified

Also published in Proc. Fifth Interamer. Seminar on Cosmic Rays, La Paz (Bolivia) (July 17-27, 1962), v. 2: paper no. 26, Sept. 1962.

Only July 18, 1959, a short-lived highly anisotropic cosmic ray increase was observed by some of the IGY network of recording stations during recovery from the third of the series of 3 closely spaced cosmic ray storms. Characteristic features and the solar and terrestrial relationships of this increase are studied. Different mechanisms proposed thus far for this increase are critically examined. Arguments are presented to the effect that this could not be a solar flare type increase. It is suggested that this increase was probably produced by galactic cosmic rays which were reflected from 'receding' Parker type blast waves formed during the explosive heating of a solar corona following the west limb 3^+ solar flare of July 16. (Contractor's abstract)

2711

[San Marcos U.] Lima (Peru).

ESTIMATION OF PORE RADIUS AT BOTH SURFACES OF ISOLATED TOAD SKIN, by G. Whittembury. [1962] [1]p. (AFOSR-1743) (AF AFOSR-61-85) Unclassified

Presented at Sixth annual meeting of the Biophys. Soc., Washington, D C., Feb. 14-16, 1962.

Published in 1962 meeting of the Biophys. Soc. Abstracts, paper no. TD 7.

This method allows the observance of swelling and shrinking of cells of isolated toad skin, when the solutions bathing either the outside or inside of the skin are changed. Thus the concentration of probing molecules of graded size, isosmic to the cells, across each face of the isolated toad skin can be determined. These concentrations have been used for the estimation of pore radius at the outer and inner face of the skin, following the approach of Goldstein and Solomon for the red cells. Pore radius of 5.0 A at the outer surface, and 6.8 A at the inner surface are obtained. Anti-diuretic hormone has an effect only when added to the inner surface; it widens the 5.0 A pores to about 6.8 A. A model membrane, formed by narrow and wide pores in series in which the main resistance to diffusion is at the wider pores, may explain some of the apparent inconsistencies previously observed. (Contractor's abstract)

2712

San Marcos U. Lima (Peru).

ACTION ON ANTIDIURETIC HORMONE ON THE EQUIVALENT PORE RADIUS AT BOTH SURFACES OF THE EPITHELIUM OF THE ISOLATED TOAD SKIN, by G. Whittembury. [1962] [14]p. incl. diagrs. tables, refs. (AFOSR-J608) (AF AFOSR-61-85) AD 414002 Unclassified

Also published in Jour. General Physiol., v. 46: 117-130, Sept. 1962.

A previously described method allows the observation of swelling and shrinking of the epithelial cells of the isolated toad skin, when the solution bathing either the outer or the inner side of the skin is modified. The equivalent pore radius at the outer and inner face of the skin epithelium can be estimated from the concentrations used; 4.5Å and 7A for the inner and outer surface pore radius, respectively, have been obtained. Antidiuretic hormone had an effect only when added to the inner side. This effect was only at the outer surface and is interpreted as widening of the 4.5A pores to about 6.5A. A model membrane, formed by narrow and wide pores in series, may explain some of the apparent inconsistencies observed. (Contractor's abstract, modified)

2713

Sao Paulo U. School of Medicine, Dept. of Physiology (Brazil).

[RADIO CONTROL OF ENCEPHALIC STIMULATION IN THE CAT] Rádio-contrôle de estimulação encefálica no gato, by R. F. Marseillan and J. B. Paulin. [1962] [1]p. (AFOSR-J931) (AF AFOSR-61-60) Unclassified

Also published in Resumos de Comunicações, v. 14: 104, 1962.

The results are given of a study on the provoked phenomenon conducted by stimulating the central nervous system on an animal. This was done by radio-frequency control of the electrical stimulus sent to implanted electrodes.

Sarah Mellon Scaife Radiation Lab., Pittsburgh, Pa.
see Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

2714

Sheffield U. (Gt. Brit.).

[FORMATION AND ROLE OF RADICALS IN FLAVOPROTEIN CATALYSES]. Final rept. 1962 [4]p. (AFOSR-4325) (AF EOAR-61-2) Unclassified

The work dealing with cytochrome oxidase on a bioluminescent system and on compounds in mixtures of oxidized and reduced flavin mononucleotide is summarized. The degree to which the cytochrome oxidase

reactions can be represented as due to partial reactions with oxygen of cytochromes a_3 and a has been extensively studied with the aid of a computer. The establishment of the life-time of reduced flavin mononucleotide in the presence of molecular oxygen was preliminary to the study of bioluminescence. Analysis of the factors involved in the luminescent reaction is still underway.

2715

Sheffield U. (Gt. Brit.).

THE NATURE OF COMPOUNDS PRESENT IN MIXTURES OF OXIDIZED AND REDUCED FLAVIN MONONUCLEOTIDES, by Q. H. Gibson, V. Massey, and N. M. Atherton. [1962] [15]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-61-2], Medical Research Council, and Public Health Service) Unclassified

Published in Biochem. Jour., v. 85: 369-382, Nov. 1962.

The composition of the equilibrium mixtures obtained by mixing known amounts of flavine mononucleotide (FMN) and reduced FMN ($FMNH_2$) have been studied by spectrophotometry, fluorimetry, and electron-spin-resonance spectrometry. The major component of the mixtures containing more than 2mM total flavine is a species absorbing at 900 mμ which is regarded as a charge transfer complex (CT) between $FMNH_2$ and FMN. Comparison of the spectrophotometric and electron-spin-resonance data show a close correlation between the extinction at 570 mμ and the concentration of the free radical. When the radical concentration is plotted against total percentage of $FMNH_2$ at constant flavine concentration, a strongly asymmetric curve is obtained with a max at about 70% reduction. Evidence is presented that this asymmetry is due to the presence of another radical species, a complex between the semiquinone and $FMNH_2$. The formation of the complex between the semiquinone and the $FMNH_2$ is inhibited in the presence of solutes such as caffeine and urea, and in various organic solvents (formamide, dimethyl sulfoxide, propylene glycol, and MeOH). In aqueous solution (0.12M phosphate, pH 6.3) the data are consistent with the following equilibria: $2FMN \xleftrightarrow{K_F = 10mM} (FMN)_2$; $2FMNH_2 \xleftrightarrow{K_{FH_2} = mM} (FMNH_2)_2$; $FMNH_2 + FMN \xleftrightarrow{K_{CT} = 0.445mM} CT$; $CT \xleftrightarrow{K_x = 10^6/M}$ $2FMNH, FMNH + FMNH_2 \xleftrightarrow{K_{FMNH_2FMNH} = 5.6mM}$ ($FMNH_2FMNH$). The effect of changing the solvent on the relation between the extinction at 570 mμ and that at 900 mμ suggests that the charge transfer complex (900 mμ band) is a precursor of the free semiquinone.

2716

Sheffield U. (Gt. Brit.).

REACTIONS OF CYTOCHROME OXIDASE WITH OXYGEN AND CARBON MONOXIDE, by Q. H. Gibson and C. Greenwood. [1962] [14]p. incl. diagrs. tables, refs. [AF EOAR-61-2] Unclassified

Published in Biochem. Jour., v. 86: 541-554, Mar. 1963.

The reaction of the Yonetani preparation of cytochrome oxidase with carbon monoxide is accurately second-order with a rate constant $8 \times 10^4 M^{-1}$ sec^{-1} at 20° and activation energy of 6.4 kcal. The dissociation velocity constant of carbon monoxide is 0.023 sec^{-1} at 20° and pH 7.4. In the Yonetani preparation, 1/3 of the total iron reacts with carbon monoxide to form the carbon monoxide compound as determined both by spectrophotometry and by gasometric methods. The reaction of oxygen with reduced cytochrome oxidase is rapid and the course of the reaction is complex. At low oxygen concentrations the approximate second-order rate constant is 6×10^7 M^{-1} sec^{-1} for the Yonetani preparation and 3×10^7 M^{-1} sec^{-1} for the Greenwood (1963) preparation. When the reaction between reduced cytochrome oxidase and oxygen is followed at different wavelengths, the course of the reaction changes. At low oxygen concentrations (less than 5 μM) the reaction proceeds faster when followed at 605 mμ than when followed at 445 mμ. At concentrations of oxygen above 10 μM, the observed changes at 605 mμ are slower than those at 445 mμ. The apparent second-order rate constant at 445 mμ and at low oxygen concentrations increases as the reaction proceeds; at high oxygen concentrations it decreases. These changes are attributed to consecutive reactions between oxygen and reduced cytochrome a_3, and between reduced cytochrome a_3 and oxidized cytochrome a. Satisfactory agreement between observation and calculation has been obtained by assuming that reduced cytochrome a_3 can react with oxygen with a velocity constant of 1.5×10^8 M^{-1} sec^{-1} and that the reaction between reduced cytochrome a and cytochrome a_3 is first-order with a rate constant of 1.5×10^3 sec^{-1}. The spectrophotometric changes at different wavelengths may be produced by using the extinction coefficients given by Yonetani.

2717

Sheffield U. (Gt. Brit.).

MICROWAVE ABSORPTION IN GADOLINIUM-YTTRIUM ALLOYS, by J. Popplewell and R. S. Tebble. [1962] [2]p. incl. diagr. table. (AFOSR-J581) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-62-54 and Department of Scientific and Industrial Research) AD 413770 Unclassified

Presented at Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15. 1962.

Also published in Jour. Appl. Phys., v. 34: 1343-1344, Apr. 1963.

The paramagnetic, antiferromagnetic, and ferromagnetic states of the gadolinium-yttrium alloy system have been examined by microwave resonance techniques. The paramagnetic g values are found to be concentration dependent ranging from 1.96 ± 0.03 in pure gadolinium to 2.13 ± 0.05 in the 3.7% gadolinium alloy. The results, in particular the experimentally determined g shifts, are discussed in terms of the Yosida development of Zener's proposal that the coupling between d (or f) spins is brought about by exchange interaction with the polarized conduction electrons. (Contractor's abstract)

Sibley School of Mechanical Engineering, Ithaca, N. Y.
see Cornell U. Sibley School of Mechanical Engineering, Ithaca, N. Y.

2718

Siena U. Inst. of Pathology (Italy).

[DISTRIBUTION OF SOMATICALLY EVOKED RESPONSES IN THE DIENCEPHALON] Distribuzione della risposte evocate nel diencefalo dalla stimolazione somatica, by P. Rudomin, G. Carli and others. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)253 and Rockefeller Foundation) AD 632638 Unclassified

Published in Boll. Soc. Ital. Biol. Sper., v. 38: 1396-1397, 1961.

The basal diencephalon of locally anesthetized cats, immobilized with gallamine, has been explored with stereotaxically oriented electrodes while the superficial radial nerve was stimulated with single pulses Potential distribution when leading with concentric bipolar needle electrodes, has been compared with the distribution of evoked responses when the inner core (180 micra in diameter) of the needle electrode was used as exploring element against an indifferent electrode on the scalp (so called monopolar recording). The diencephalic area which appears to be activated by somatic impulses when the monopolar arrangement is used is much larger than the area wherefrom responses are recorded with the bipolar concentric lead. The possibility that unipolar leads may also record activity spread from some distance is discussed. (Contractor's abstract)

2719

Siena U. Inst. of Pathology (Italy).

[SHAM RAGE BEHAVIOR OF THE ACUTE DECORTICATE CAT AFTER INTERRUPTION OF ASCENDING PATHWAYS TO THE HYPOTHALAMUS] Comportamento di falsa rabbia nel gatto decorticato dopo interruzione delle vie di proiezione ascendente all'ipotalmo, by G. Carli, A. Malliani, and A. Zanchetti. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)253 and National Research Council) AD 632637 Unclassified

Published in Boll. Soc. Ital. Biol. Sper., v. 38: 1398-1399, 1961.

Sham rage behavior persists unmodified after acute interruption of the mammillary peduncle system either at the caudal or at the rostral midbrain level, or after destruction of the rostral pole of the mesencephalic gray matter. (Contractor's abstract)

2720

Siena U. Inst. of Pathology (Italy).

CENTRAL NERVOUS MECHANISMS IN CIRCULATION REGULATION, by C. Bartorelli and A. Zanchetti. May 31, 1962, 13p. incl. refs. (AF 61(052)253) AD 632506 Unclassified

The diencephalic mechanisms for rage were found to be under the inhibitory control of sino-aortic pressoceptors, and to be excited by chemoceptive firing. Inhibitory as well as excitatory effects can be induced also from the reticular formation. Lesion experiments indicate that rate activity is supported by the activating reticular system. Mapping diencephalic responses to somatic stimuli has been to define some limited foci of activation. A tonic inhibitory role on arterial pressure exerted by afferents from heart and lungs is described. (Contractor's abstract)

2721

Siena U. Inst. of Pathology (Italy).

CENTRAL NERVOUS MECHANISMS IN CIRCULATION REGULATION AND FUNCTIONAL DERANGEMENT (HYPERTENSION), by C. Bartorelli. Annual summary rept. no. 1, May 1, 1960-Apr. 30, 1961, 8p. incl. refs. (AF 61(052)253) AD 632584 Unclassified

The investigations carried out include an analysis of: (1) ascending, inhibitory, and excitatory mechanisms regulating autonomic and somatic hypothalamic activity and sham rage behavior, (2) the interrelationship between posterior hypothalamus, brain stem and cardiovascular afferents, and (3) different brain stem contributions to circulatory control. The plans for the following quarter are also discussed.

2722

Siena U. Inst. of Pathology (Italy).

FUNCTIONAL RELATIONSHIP BETWEEN MIDBRAIN RETICULAR FORMATION AND LATERAL HYPOTHALAMUS (Abstract), by P. Rodomin, A. Malliani, and A. Zanchetti. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)253 and Rockefeller Foundation) Unclassified

Published in Proc. Internat'l. Union of Physiological Sciences; Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 2: Abstract no. 1131, 1962.

Experiments have been performed in locally anesthetized cats to compare the afferent projections from the

somatic system (single pulses to one radial nerve) to both midbrain reticular formation and lateral hypothalamus. Preamplifier filters were set so that both slow waves and unit responses could be recorded by means of tungsten microelectrodes. The following data suggest that somatic impulses may affect the 2 structures parallely, although partially independent activation can also occur. (1) No fixed relationship between the latencies of the potentials evoked in the 2 regions has been observed, the hypothalamic often trailing, but sometimes leading the reticular response. (2) Simultaneous waxing and waning of both types of response shows that their peak amplitudes are positively correlated. (3) The ratio of hypothalamic to reticular potentials is increased when measured on responses to a second stimulus of a pair (240 msec delay), or after small doses of Thiopental thus indicating that the hypothalamus is relatively less depressed.

2723

Siena U. Inst. of Pathology (Italy).

INHIBITION OF DIENCEPHALIC SHAM RAGE BEHAVIOR BY LOWER BRAIN STEM STIMULATION (Abstract), by G. Carli, A. Malliani, and A. Zanchetti. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)253 and Consiglio Nazionale delle Recherche) Unclassified

Published in Proc. Internat'l. Union of Physiological Sciences; Twenty-second Internat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Foundation. v. 2: Abstract no. 1134, 1962.

The effects of electrical stimulation of medulla and pons through stereotactically directed electrodes have been studied in 70 actute decorticate cats. Either excitation or inhibition of sham rage behavior, as well as postural reactions, could be elicited from the lower brain stem. Attention is directed toward the inhibitory responses only. The following results have been obtained. (1) Threshold stimulation (1-2 volts, 25-100 c/sec, 1 msec) of several tegmental points could block the spontaneously recurring or reflexly evoked outbursts of rage, while being without any effect when timed during an interval of quiet of the preparation. Both somatic and automatic (pupillary, respiratory, and circulatory) components of rage behavior were simultaneously inhibited. (2) The inhibitory response was independent of co-stimulation of cerebellofugal fibers coursing through the brain stem, as it could be obtained also in cats which had undergone total cerebellectomy 14-21 days before. (3) Inhibition of sham rage could be elicited only from the medial portions of the reticular formation, but inhibitory and excitatory points were quite intermingled. (Contractor's abstract)

2724

Siena U. Inst. of Pathology (Italy).

MIDBRAIN COURSE OF DESCENDING PATHWAYS MEDIATING SHAM RAGE BEHAVIOR, by G. Carli, A. Malliani, and A. Zanchetti. [1962] [14]p. incl. illus. refs. (Sponsored jointly by [Air Force Office of Scientific Research] under AF 61(052)253 and Consiglio Nazionale delle Recherche) Unclassified

Published in Exper. Neurol., v. 7: 210-223, Jan. 1963.

The midbrain course of descending pathways mediating sham rage behavior has been investigated in thalamic cats. Electrical stimulation of the lateral hypothalamus has been tested for rage outbursts before and following various lesions in the midbrain. The following lesions were found not to impair transmission of the descending hypothalamic influences: transection of the rostral third of the central periaqueductal gray and adjacent tegmentum, with interruption of the hypothalamic component of Schütz's dorsal longitudinal fasciculus; midline lesions, including the medial component of the medial forebrain bundle to the ventral tegmental area of Tsai and to the caudal periaqueductal gray; and lateral tegmental lesions involving the lateral component of the medial forebrain bundle to the lateral midbrain tegmentum. Large lesions involving most, though not all, of the tegmentum at the midcollicular level impaired, but did not abolish, rage responses to lateral hypothalamic stimulation. It is concluded that descending connections from the lateral hypothalamus, responsible for the peripheral manifestations of rage, are diffuse through the midbrain, including both the lateral and the medial components of the medial forebrain bundle, and possibly the dorsal longitudinal fasciculus as well.

2725

Siena U. Inst. of Pathology (Italy).

TONIC REFLEX REGULATION OF THE CAT'S BLOOD PRESSURE THROUGH VAGAL "NON-AORTIC" AFFERENTS, by M. Guazzi, A. Libretti and A. Zanchetti. [1962] [2]p. incl. diagrs. (AF 61(052)253) AD 632650 Unclassified

Published in Experientia, v. 18: 185-186, 1962.

The experiments have succeeded in demonstrating the quantitative importance of the tonic reflex influence exerted by afferent vagal fibers on arterial pressure, its independence of concomitant respiratory changes, and that its origin is different from that of the classical afferent fibers running in the aortic nerve. (Contractor's abstract)

Sloane Physics Lab., New Haven, Conn.
see Yale U. Sloane Physics Lab., New Haven, Conn.

2726

Smithsonian Inst. Astrophysical Observatory, Cambridge, Mass.

NEW DESIGN FOR A GAS-FLOW PROPORTIONAL COUNTER, by F. B. Riggs, Jr. [1962] [4]p. incl. illus. diagrs. refs. (AF 18(600)1596) Unclassified

Published in Rev. Scient. Instr., v. 34: 332-395, Apr. 1963.

Describes a compact design for a gas-flow proportional counter. Externally adjustable end plates for correcting the electric field allow pulse-height distribution curves comparable with those from long counters, although the counting volume is 1¼ in. in diameter and 1 1/16 in. long. A transistorized preamplifier inside the counter case provides clear pulses with low background in a low impedance line. The gas-flow proportional counter described here has 3 significant features: (1) low noise, approximately 1% of the FeK_{α} pulse height; (2) low impedance output from the first preamplifier; (3) energy spread less than 20%, in spite of short length and large diameter

2727

Smithsonian Inst. Astrophysical Observatory, Cambridge, Mass.

PRECISE ALIGNMENT USING TEFLON-COATED STEEL, by C. W. Peterson and F. B. Riggs, Jr. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1596 and National Science Foundation) Unclassified

Published in Rev. Scient. Instr., v. 34: 114, Jan. 1963.

The smooth alignment of heavy instruments was achieved with a positioning table and with a heavy telescope by use of a Teflon-steel and Teflon-Teflon bearings.

2728

South Carolina U. Dept. of Chemistry, Columbia.

REACTIONS OF FREE RADICALS WITH AROMATIC RINGS, by D. F. DeTar. Final rept. Sept. 1, 1957-Aug. 31, 1961. Oct. 1, 1962 [13]p. incl. diagrs. (In cooperation with Florida State U., AF AFOSR-62-279) (AFOSR-1373) (AF 49(638)88) Unclassified

This report is a summary of work accomplished: (1) An intensive study of the reaction of benzoyl peroxide with benzene and the reaction of chlorobenzoyl peroxide with benzene, (2) Studies of cyclization via free radicals, and (3) Studies of diazonium ion-diazotate equilibria. This has implications for the Gomberg-Bachmann reaction.

2729

South Carolina U. Dept. of Electrical Engineering, Columbia.

MILLIMETER WAVE TRANSMISSION BY NON-WAVEGUIDE MEANS, by R. G. Fellers. [1962] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-3928) (AF 18-(603)43) Unclassified

Also published in Microwave Jour., v. 5: 80-86, May 1962

For abstract see item no. 2730, Vol. VI.

2730

South Carolina U. Dept. of Electrical Engineering, Columbia.

MILLIMETER WAVE TRANSMISSION BY NON-WAVEGUIDE MEANS, by R. G. Fellers. [1962] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-J366) (AF 18(603)-43) AD 450098 Unclassified

Also published in Microwave Jour., v. 5: 80-86, May 1962.

This paper discusses an investigation of the use of free space transmission between a pair of appropriately spaced and designed radiators as a possible replacement for waveguide transmission within a millimeter wavelength system. In developing a free space transmission system, it is necessary to design and develop devices which will perform the same functions in free space as those performed by conventional waveguide components and instruments. Among the needed devices are duplexers, directional couplers, attenuators, wave meters, hybrid junctions, reflectometers and a means of transmission around corners.

2731

South Carolina U. Dept. of Electrical Engineering, Columbia.

[NON-WAVEGUIDE METHODS OF MILLIMETER WAVE TRANSMISSION], by R. G. Fellers. Final rept. Apr. 1, 1961-Mar. 31, 1962. Aug. 1962, 21p. incl. diagrs. tables. (AFOSR-3535) (AF AFOSR-61-53) AD 285390 Unclassified

This research concerns the study of millimeter electromagnetic wave diffraction theory, design of various geometries for transmission and reflection of these waves, design of new antenna feed systems, and the adaptation of optical frequency methods to the solution of millimeter wave problems.

2732

South Carolina U. [Dept. of Physics] Columbia.

[COLLECTION OF LOW SPEED ELECTRONS BY METALLIC SURFACES], by [W. R. Ferris]. Final rept. [1962] 8p. (AFOSR-3532) (AF 49(638)175) AD 288282 Unclassified

The collection of very low velocity electrons by metallic surfaces is a complex phenomenon and merits further study. Contamination is always present and may be a powerful factor in the behavior of a particular surface. The electrons rejected by a surface influence the characteristics of electron devices in many ways, among them being the macroscopic phenomenon known as "black out" as well as second order effects such as gain variation in dc amplifiers, frequency drift in oscillators, and noise in high gain amplifiers. (Contractor's abstract)

2733

Southampton U. (Gt. Brit.).

REACTION OF VANADIUM (IV) CHLORIDE WITH SOME ALIPHATIC AMINES, by M. W. Duckworth and G. W. A. Fowles. [1962] [7]p. (AF 61(052)318)
Unclassified

Published in Jour. Less-Common Metals, v. 4: 338-344, 1962.

The reactions at room temperature of VCl_4 with an excess of several primary and secondary aliphatic amines are studied. Each primary amine (NH_2R, R = Me, Et, Pr and Bu) gives an aminobasic VCl_4, $VCl_2(NHR)_2 \cdot NH_2R$, which is insoluble in the usual organic solvents. The thermal decomposition of these compounds shows that amine is steadily lost when heated in vacuo up to 100°, although there is apparently no composition of particular stability. Nevertheless, at ~ 60°, these substances change color from green to purple, indicating a change in the environment of the V atom. Two V-Cl bonds are aminolyzed by the secondary amines (NHR_2, R = Me, Et, Pr). Structures for the compounds are proposed on the basis of spectroscopic studies. (Contractor's abstract)

2734

Southern California U. Dept. of Chemistry, Los Angeles.

REACTIONS OF THE 2-BORNYL RADICAL. I. THE DECARBONYLATION OF 2-FORMYLBORNANE, by J. A. Berson and C. J. Olsen. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-2313) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(600)1544, Alfred P. Sloan Foundation, Office of Ordnance Research and Richfield Oil Corp.)
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 3178-3183, Aug. 20, 1962.

The di-t-butyl peroxide-induced decarbonylation of 2-formylbornane in the liquid phase at 138° gives mainly bornane and traces of bornene and tricyclene as the sole C_{10}-hydrocarbon products. The hypothetical rearrangement product 2,3,3-trimethylnorbornane (isocamphane) is not observed and cannot be present to an extent greater than about 0.1% of the total volatile hydrocarbon formed. The chain length for carbon monoxide production in the decarbonylation varies with the ratio of peroxide to aldehyde used and ranges from about 0.4 to 4.8 as the ratio changes from about unity to about 0.1. At high initial ratios, the yields of disproportionation products (bornene and tricyclene) increase at the expense of bornane, suggesting an increased importance of radical-radical reactions relative to hydrogen abstraction. (Contractor's abstract)

2735

Southern California U. Dept. of Chemistry, Los Angeles.

REACTIONS OF THE 2-BORNYL RADICAL. II. A FREE RADICAL WAGNER-MEERWEIN REARRANGEMENT, by J. A. Berson, C. J. Olsen, and J. S. Walia. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-2314) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1544, Alfred P. Sloan Foundation, Office of Ordnance Research and Richfield Oil Corp.)
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 3337-3348, Sept. 5, 1962.

The thermal decomposition of 2-azobornane in the solvents diphenyl ether and n-hexadecane at temperatures above 250° gives a mixture of hydrocarbons, among which is 2,3,3-trimethylnorbornane (isocamphane), resulting from formal Wagner-Meerwein rearrangement. The latter hydrocarbon arises by a cleavage-recyclization mechanism, an interpretation supported by the formation of isocamphane as well as bornane, 1-p-menthene, tricyclene and bornene in the decomposition of either 2-azocamphane or 1-azo-cis-2(2,2,3-trimethyl-3-cyclopentenyl)-ethane. Further support for classical rather than mesomeric product-forming intermediates is provided from the normal rates of decomposition of the azo compounds, from the dependence of the product distribution on the source of radicals, and from the stereochemistry of the hydrogen-abstraction by the 2,3,3-trimethyl-2-norbornyl radical, which gives both isomers of isocamphane. (Contractor's abstract)

2736

Southern California U. Dept. of Chemistry, Los Angeles.

CONDUCTIVITY OF MIXED SODIUM DECYL AND DODECYL SULFATES- THE COMPOSITION OF MIXED MICELLES, by K. J. Mysels and R. J. Otter. [1961] [12]p. incl. diagrs. table, refs. (AFOSR-1949) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)309 and Office of Naval Research)
Unclassified

Presented at 139th meeting of the Nat'l. Amer. Chem. Soc.; Symposium on Structure of Micellar Solutions. Mar. 1961.

Also published in Jour. Colloid Sci., v. 16: 462-473, Oct. 1961.

Precise measurements of conductivity of solutions of pure sodium decyl and dodecyl sulfates and their mixtures in the region of the critical micelle concentration (cmc) are reported and the cmc values of the mixed systems are evaluated. An empirical interpretation of these results is proposed which leads to a self-consistent assignment of composition to the mixed micelles. This interpretation is based on an extrapolation - the conductivity vs concentration plot, to obtain the concentration of monomers in a mixed solution in the same way in which the cmc is obtained in a pure system. This extrapolated concentration is assumed to be the cmc of the mixed monomers, again in analogy with the

pure system. This concentration therefore determines the composition of the equilibrium monomers. The composition of the mixed micelles is then calculated by difference. (Contractor's abstract)

2737

Southern California U. Dept. of Chemistry, Los Angeles.

THERMODYNAMIC ASPECTS OF MIXED MICELLES-APPLICATION TO AN EMPIRICALLY ESTABLISHED EQUILIBRIUM, by K. J. Mysels and R. J. Otter [1961] [7]p. incl. diagrs. refs. (AFOSR-1949A) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)309 and Office of Naval Research) Unclassified

Presented at 139th meeting of the Nat'l. Amer. Chem. Soc.; Symposium on Structure of Micellar Solutions, Mar. 1961.

Also published in Jour. Colloid Sci., v. 16: 474-480, Oct. 1961.

Relationships between the overall composition, in terms of mole fraction of 2 micelle-forming components, in a solution of these 2 components and the critical micelle concentration on the one hand and the composition of the mixed micelles on the other, are reviewed and activity coefficients introduced to account for the behavior of real systems. It is shown that the behavior of the critical micelle concentration is not a sufficient criterion for the ideality of the system, that the contribution to nonideality of the 2 components can be resolved, and that the ideality of the monomeric solution may be tested if the composition of mixed micelles is known. These considerations are applied to the results obtained in (see item no. 2736, Vol. VI) for the sodium decyl and dodecyl sulfates and indicate definite deviations from ideality for the whole system as well as for the monomeric solution. These deviations are, however, not very large and affect the mixed critical micelle concentration insignificantly. (Contractor's abstract)

2738

Southern California U. Dept. of Chemistry, Los Angeles.

AN APPROACH TO GAS MEMBRANE OSMOMETRY, by K. J. Mysels and E. Gonick. [1961] [3]p. (AFOSR-1951) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)309, National Science Foundation and Research Corp.) Unclassified

Also published in Jour. Phys. Chem., v. 65: 1631-1633, Sept. 1961.

Osmometry is, in principle, the most sensitive method of measuring colligative properties. Truly semipermeable membranes are scarce. The membrane formed by an inert gas held in nonwetted capillaries between the solvent and the solution is discussed. The gas-phase gap is permeable to H_2O vapor but completely impervious to any nonvolatile solvent. Membranes are prepared by siliconizing a commercial membrane filter of high porosity, pores ≤ 1 μ. In these membranes, thermal contact between the 2 surfaces is relatively good. Membranes thus prepared are compared with those prepared by the porous-disk method; heat transport between the 2 surfaces is quite slow in these membranes. The driving force for the transport of solvent in membranes prepared by either method is the difference in vapor pressure between the 2 surfaces. The experimental rate is considerably higher than the theoretical one. The osmometer used is a modification of the application described by Scatchard, et. al. Experiments are conducted mainly with 3×10^{-4}M KCl on the solution side. Steady values are difficult to obtain; probable causes for this are discussed. It is not always possible to calculate the rate of transport, even when steady values are obtained. (Math. Rev. abstract)

2739

Southern California U. Dept. of Chemistry, Los Angeles.

SOAP FILMS AS A TOOL FOR THE STUDY OF COLLOIDAL STABILITY, by J. Lyklema. [1962] [8]p. incl. diagrs. refs. (AFOSR-2891) (AF 49(638)309) AD 400173 Unclassified

Also published in Recueil Trav. Chim. Pays-Bas, v. 81: 890-897, Sept./Oct. 1962.

The same factors that govern the stability of hydrophobic colloidal systems influence the behavior of thin detergent films. The study of soap films can therefore clarify many of the problems relating to colloidal stability, and vice versa. The advantages and limitations of the soap film approach are discussed. An interesting way of performing such experiments is to investigate the thickness of slowly formed soap films. Some results of this method are set forth. (Contractor's abstract)

2740

Southern California U. [Dept. of Chemistry] Los Angeles.

FLOW IN THIN LIQUID FILMS, by J. Lyklema, P. C. Scholten, and K. J. Mysels. [1962] [24]p. incl. diagrs. table, refs. (AFOSR-5174) (AF 49(638)369) AD 416373 Unclassified

Also published in Jour. Phys. Chem., v. 69: 116-123, Jan. 1965.

An improved experimental method for studying vertical soap films slowly pulled out of a solution is described and the interpretation of the optical thickness measurements is discussed. The behavior of molecule films presents complications which are described. Rigid films on the other hand give results for films thicker than 800-1100 A, which agree very closely with Frankel's law relating film thickness to the velocity of pull-out. Since Frankel's law is derived on the assumption that the viscosity is constant up to the monolayer, this agreement proves the absence of any thick rigidified water layers (or of slip) in the neighborhood of the surface. (Contractor's abstract)

2741

Southern California U. Dept. of Chemistry, Los Angeles.

INORGANIC SULFUR REAGENTS. I. THE THIONYL HALIDES, by C. M. Buess, N. Kharasch, and R. B. Langford. [1961] [15]p. incl. diagrs. table, refs. (AFOSR-266) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)718 and Stauffer Chemical Co.) Unclassified

While it is clear that many compounds of the inorganic sulfur reagents have now become of the greatest theoretical and practical interest, yet there has been a lack of correlative and review papers which would serve to focus attention on them. It seemed desirable to prepare a series of brief articles, each of which would give a thorough entry to the literature on a selected group of these substances. The present paper concerns the thionyl halides, SOX_2. The known examples of this group of compounds are shown, together with the other known compounds of sulfur and halogen, and of sulfur, oxygen and halogen.

2742

Southern California U. Dept. of Chemistry, Los Angeles.

SULFENIC ACIDS AND THEIR DERIVATIVES. XLI. SULFENYL NITRATES AND SULFINYL RADICALS, by R. M. Topping and N. Kharasch. [1962] [4]p. (AFOSR-267) (AF 49(638)718) AD 621222 Unclassified

Also published in Jour. Org. Chem., v. 27: 4353-4356, Dec. 1962.

Sulfenyl nitrates, $RSONO_2$, represent a novel class of sulfenyl compounds. The preparation of the first examples is described and some of their properties are recorded. The near-quantitative conversion of sulfenyl nitrates to thiosulfonate esters ($2RSONO_2 \rightarrow RSO_2SR + 2NO_2$) is demonstrated and interpreted as a dimerization reaction of sulfinyl radicals. (Contractor's abstract)

2743

Southern California U. Dept. of Chemistry, Los Angeles.

THE INTRAMOLECULAR THERMAL REARRANGEMENT OF THE BICYCLO[3.2.0]HEPTENYL TO THE BICYCLO[2.2.1]-HEPTENYL SYSTEM, by J. A. Berson and J. W. Patton. [1962] [2]p. incl. diagrs. refs. (AFOSR-3905) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)828 and Petroleum Research Fund) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 3406-3407, Sept. 5, 1962.

The stereospecific thermal isomerization of syn-cis-bicyclo[3.2.0]hept-2-enyl-6-acetate to exo-5-norbornenyl-2-acetate is reported. The 2 most likely mechanisms for the conversions are: (1) cleavage at carbon 1 and carbon 7, establishment of a double bond at carbon 1 and carbon 2, and re-cyclization by connection of carbon 7 and carbon 3; and (2) formation of a vinyl-cyclopropane from a cyclopentene, followed by conversion of the latter to a different cyclopentene.

2744

Southern California U. Dept. of Chemistry, Los Angeles.

ABSOLUTE INFRARED INTENSITIES IN CRYSTALLINE C_2H_4 AND C_2D_4, by G. M. Wieder and D. A. Dows. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-64-0126) (AF 49(638)1308) AD 431073 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2990-2995, Dec. 15, 1962.

Absolute infrared intensities of the ungerade fundamentals of crystalline C_2H_4 and C_2D_4 have been measured under high spectral resolution at 63°K and compared with the available intensity data in the gas phase. The intensity changes from gas to solid vary considerably among modes of the same symmetry species. Attempts to predict the transfer of intensity among certain vibrational modes in the crystal by an intermolecular hydrogen repulsion coupling mechanism have met with limited success. Intensity sum rules are discussed. (Contractor's abstract)

2745

Southern California U. [Dept. of Electrical Engineering] Los. Angeles.

ELECTROMAGNETIC RADIATION FROM AN ELECTRIC DIPOLE IN A COLD ANISOTROPIC PLASMA, by H. H. Kuehl. [1962] [9]p. incl. diagrs. (AFOSR-J126) (AF 49(638)522) AD 400447 Unclassified

Also published in Phys. Fluids, v. 5: 1095-1103, Sept. 1962.

The general solution to the problem of monochromatic radiation from an electric dipole in a magnetically biased, cold tenuous plasma is presented. It is found that, generally, several waves exist in the radiation zone, traveling in different directions with different indices of refraction. For certain ranges of the plasma, gyro, and operating frequencies, the field becomes very large in certain directions compared with that in other directions, producing highly directive radiation characteristics. In general, the expression for the field is quite complicated although several special cases are treated which yield simple solutions. For high operating frequency it is found that the radiation pattern is identical to the isotropic case although a Faraday rotation takes place. Solutions are given for low and very low frequencies which place in evidence the guiding nature of the magnetostatic field. For the case of a large magnetostatic field it is shown that only 2 waves exist and that the time-average power flow is purely radial. (Contractor's abstract)

2746

Southern California U. Engineering Center, Los Angeles.

NOTE ON VISCOUS AND DIFFUSION STRESSES IN A MULTI-COMPONENT GAS MIXTURE, by J. C. Williams, III. [1961] 5p. (AFOSR-1230) (AF 49(638)-831) Unclassified

From a physical point of view, it does not seem logical to divide the stress tensor into viscous and diffusion parts since at the microscopic level the same velocities which are involved in the transport of momentum, and hence give rise to viscosity, are involved in diffusion. In fact, one might argue that viscous stresses arise from the diffusion of momentum. This view would be consistent with the fact, pointed out by von Kármán, that the viscosity coefficient for the mixture is defined in such a way that the momentum transfer by means of diffusion is included into the viscous stress components.

2747

Southern California U. Engineering Center, Los Angeles.

KINETIC EQUATIONS FOR PLASMAS, by T. Koga. [1962] [7]p. incl. diagrs. refs. (AFOSR-2006) (AF 49-(638)831) Unclassified

Also published in Phys. Fluids, v 5: 705-711, June 1962.

The effect of the inner-core field which is induced by a charged particle within the Landau distance and has been neglected in current kinetic theories of plasmas, is investigated from the transport-theory viewpoint. In the equation for a 1-particle distribution function, the effect of the outer-core field between the Landau distance and the Debye distance is represented by the friction and diffusion terms of the Fokker-Planck type, while the effect of the inner-core field is represented by the collision term of the Boltzmann type. The magnitudes of these terms are compared with each other. It is shown that the collision term may be larger than the friction and diffusion terms under certain conditions. When the effect of the outer-core field is larger than that of the inner-core field, the assumption of weak interaction is shown not to be valid. The possible nonlinear and non-Markovian behavior of a particle is considered only implicitly. The radiation phenomena are neglected. (Contractor's abstract)

2748

Southern California U. Engineering Center, Los Angeles.

PRESSURE LAG THROUGH ORIFICES AND SHORT TUBES FOR SMALL PRESSURE RATIOS AND FLOW CONDITIONS FROM FREE MOLECULE TO CONTINUUM by J. G. Everton and F. O. Smetana. Jan. 1962, 36p. incl. illus. diagrs. (USCEC rept. no. 83-211) (AFOSR-2360) (AF 49(638)831) AD 274626 Unclassified

Experiments were conducted to determine the time required for the pressure in a 1-l volume to rise to 33% of final value when filled through a short tube. Tube length to diameter ratios of 0.5 to 8.0 were tested. Initial pressure in the volume ranged from about 25μ to about 25 mm. The pressure at the upstream end of the fill tube was maintained at 1.25 times the initial pressure in the volume for all runs. A rapidly acting pneumatic valve was opened to connect the 2 chambers. It was found that the fill time could be predicted quite satisfactorily at both pressure extremes by variants of conventional theory. At intermediate pressure, however, no satisfactory theoretical prediction was found. (Contractor's abstract)

2749

Southern California U. Engineering Center, Los Angeles.

THE CRITERION OF RAREFACTION OF PLASMAS, by T. Koga. Mar. 1962 [9]p. incl. diagr. (USCEC rept. no. 83-212) (AFOSR-2361) (AF 49(638)831) AD 274627 Unclassified

According to the analysis of kinetic equations of particles in plasmas given in a previous report (see item no. 2664, Vol. V) rarefaction of a plasma is defined. The criterion of rarefaction is divided into 2 parts: 1 is the condition of the discrete binary interactions of particles which permits us to define a free path; the other is the comparison between the mean free path and a representative dimension of the field (the Knudsen number). The first condition is determined by the number density of particles and the temperature (the average energy of random motions of particles). In the regime of rarefaction, the basic kinetic equations are of the Boltzmann type. (Contractor's abstract)

2750

Southern California U. Engineering Center, Los Angeles.

A STUDY OF COMPRESSIBLE AND INCOMPRESSIBLE VISCOUS FLOW IN SLENDER CHANNELS, by J. C. Williams, III. June 1962 [81]p. incl. diagrs. refs. (USCEC rept. no. 83-213) (AFOSR-2361) (AF 49(638)-831) AD 277587 Unclassified

An analytical study is made of viscous compressible and incompressible flow in slender channels. By performing an order of magnitude analysis, similar to that employed in deriving the Prandtl boundary layer equations, a set of approximate equations of motion, valid for the entire compressible or incompressible viscous flow field in slender channels, was obtained. These approximate equations of motion are identical with the Prandtl boundary layer equations. It is found that accurate similar solutions in the incompressible 2-dimensional problems are possible for flows in convergent or divergent channels with plane walls. For incompressible axisymmetric flow, similar solutions are possible for flow in channels where the wall shape varies exponentially with the distance along the channel. In the case of 2-dimensional compressible flow with adiabatic walls, similar solutions are possible for a variety of wall shapes and pressure gradients. A detailed study of compressible flows

in convergent-divergent channels is made to determine the effects of viscosity on the location of the sonic line, on the pressure ratio at the geometric throat and on the discharge coefficient for such channels. (Contractor's abstract)

2751

Southern California U. [Engineering Center] Los Angeles.

SELF-SIMILAR AND PSEUDOSIMILAR SOLUTIONS OF BLAST WAVES IN ELECTROGASDYNAMICS, by K. Oshima. Aug. 1962, 3?p. incl. diagrs. tables, refs. (USCEC rept. no. 83-215) (AFOSR-3672) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)831 and Office of Naval Research)
AD 284914 Unclassified

Also published in Jour. Phys. Soc. Japan, v. 19: 1057-1063, June 1964.

Using the electrogasdynamical equations and the Poisson equation, a characteristic length Re, which is proportional to the Debye length divided by a ionization rate of a gas, is defined. The length plays an important role in the electrogasdynamical blast wave. Since the classical gasdynamical blast wave with a constant energy contained in it has a characteristic length, (Ro), which is defined by the constant energy, the essential parameters of the electrogasdynamical blast wave with a constant energy in it are Ro and Re, or the square of its ratio, Ao. A self-similar solution of the electrogasdynamical blast wave is found. Its shock front propagates exponentially with time and its energy also increases exponentially with time. Several numerical calculations with various values of the parameter, Re, have been carried out. This solution contains a classical gasdynamical blast wave as a limiting case of Re approaches infinity. (Contractor's abstract)

2752

Southern California U. Engineering Center, Los Angeles.

ON THE CURRENT COLLECTED BY A CHARGED CIRCULAR CYLINDER IMMERSED IN A TWO-DIMENSIONAL RAREFIED PLASMA STREAM, by F. O. Smetana. [1962] [27]p. incl. diagrs. table. (AFOSR-3684) (Sponsored jointly by Aeronautical Systems Division, Air Force Office of Scientific Research under AF 49(638)831 and Rome Air Development Center)
Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 2: 65-91, 1963 (AFOSR-5310)

Assuming that the concentration of ions and electrons near a small, charged cylinder in a plasma stream does not alter the symmetry of the force field appreciably, one can determine the trajectory of any particle in the stream when under the influence of this field, provided the motion is collisionless. By summing over all particle velocities in the undisturbed stream (one may take a Maxwell-Boltzmann distribution), it is possible to find the number of orbits which intersect the cylinder. This depends among other things upon the radial extent of the field. When the field extends more than 10 cylinder radii, the flux varies but slightly with changes in field extent. The same is true when the field extent is very small. For intermediate field extent considerable error can result if the value is not known reasonably well. An approximate Poisson equation is developed and solved and this appears to yield errors in the flux no larger than 10%. The results of the numerical integrations for the cylinder current are presented graphically. (Contractor's abstract)

2753

Southern California U. Engineering Center, Los Angeles.

THE GENERALIZED VALIDITY OF THE BOLTZMANN EQUATION FOR IONIZED GASES, by T. Koga. [1962] [19]p. incl. diagrs. table, refs. (AFOSR-3685) (AF 49(638)831) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 1: 75-93, 1963. (AFOSR-5312)

It is suggested that, in kinetic equations for plasmas, the effect of the inner core field induced by a charged particle within the Landau distance is, in most practical cases, larger than the effect of the weak field outside the Landau distance. The predominant effect is represented by collision terms of the Boltzmann type. The criterion of rarefaction of plasmas is considered. The incoherent radiation phenomena are neglected. (Contractor's abstract)

2754

Southern California U. Engineering Center, Los Angeles.

INTERACTIONS OF CHARGED PARTICLES IN PLASMAS, by T. Koga. [1961] [12]p. incl. diagr. (AFOSR-3686) (AF 49(638)831) Unclassified

Three dimensionless numbers are considered. The first is the average kinetic energy of a particle divided by the macroscopic Coulomb potential, the second, amplitude of potential fluctuation divided by the average kinetic energy, and the third, the number which represents the frequency of strong encounters. By means of these numbers, plasmas are classified into several types The condition under which Boltzmann-type equations are valid is considered.

2755

Southern California U. [Engineering Center] Los Angeles.

INTERACTION BETWEEN A RADIO WAVE AND A HIGH-TEMPERATURE PLASMA, by T. Koga. [1962] [6]p. incl. diagrs. (AFOSR-3687) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)831] and Office of Naval Research) Unclassified

Published in Phys. Fluids, v. 5: 1552-1557, Dec. 1962.

The effect of the temperature of a fully ionized plasma on its conductivity to a radio wave is investigated, taking into consideration the finite wavelength of the radio wave. The order of the effect is $kT/(ma^2)$, where T is the temperature of the gas, m the mass of an electron, k the Boltzmann constant, a the phase velocity of the wave. The relativistic effect is not considered.

2756

Southern California U. Engineering Center, Los Angeles.

EXPERIMENTAL STUDY OF HYPERSONIC RAREFIED FLOW NEAR THE LEADING EDGE OF A THIN FLAT PLATE, by R. L. Chuan and S. A. Walter. [1962] [15]p. incl. illus. diagrs. tables. (AFOSR-3688) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)831 and Office of Naval Research) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) June 1962), New York, Academic Press, Suppl. 2, v. 2: 328-342, 1963. (AFOSR-5310)

Measurements of surface pressure and pitot pressure distributions in the neighborhood of the leading edge of a thin flat plate are made under 2 sets of flow conditions: $M_\infty \sim 6$, λ_∞ 0.01 cm and $M_\infty \sim 8$, $\lambda_\infty \sim 0.4$ cm. The surface pressure behavior appears to follow continuum hypersonic viscous interaction prediction, with a monotonic increase of pressure with increasing value of the hypersonic interaction parameter, $\chi = \frac{\sqrt{C_\infty M_\infty^3}}{\sqrt{Re_\infty}}$, even to values of χ beyond the validity of theory, although the slope of p vs χ is much lower than predicted. There is no leveling of the pressure to a constant value, as predicted both by the continuum theory of Oguchi and the kinetic theory of Charwat, even at distances of the order of one mean free path from the leading edge. Pitot pressure profiles reveal a straight transition boundary between free stream and disturbed flow, (not necessarily a shock), beginning at the leading edge and inclined at an angle that is the same for $M_\infty \sim 6$, and $M_\infty \sim 8$. Velocity slip at the wall, amounting to as high as 60% of free stream velocity, is measured. Local skin friction coefficient calculated from measured pitot pressures agrees fairly well with continuum theory. (Contractor's abstract)

2757

Southern California U. Engineering Center, Los Angeles.

THE BOLTZMANN EQUATION FOR ELECTRONS IN A PLASMA, by T. Koga, J. G. Everton, and P. C. Wilber. [1962] [7]p. incl. table. (AFOSR-3689) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)831 and Office of Naval Research) Unclassified

A model of plasmas is proposed in this letter. Since electromagnetic fields are induced by charged particles, interactions between the charged particles are fairly complicated so that, the usual concept of collision is not valid. In a sense of approximation, the collision may be separated from group interaction under the condition that $3kT/2 > e^2 n^{1/3}$. Here, 3kT/2 is the average energy of motion of a particle, e the electronic charge, and n the number density of charged particles. In this note, it is propsed that several plausible assumptions by which the solution to these equations may be approached: (1) The probability of mutual collisions between electrons is negligibly small compared with the probability of collisions between electrons and heavy particles; and (2) The mass of a heavy particle is much larger than the mass of an electron. There are 3 types of collisions between an electron and a heavy particle that are considered: (a) simple collision, (b) ionization collision, and (3) recombination collision.

2758

Southern California U. Engineering Center, Los Angeles.

RESEARCH ON RAREFIED GASDYNAMICS AND PLASMADYNAMICS, by R. L. Chuan. Sept. 1962, 118p. incl. illus. diagrs. tables, refs. (USCEC rept. no. 83-101) (AFOSR-4641) (AF 49(638)831) AD 406432 Unclassified

Research activites in the field of rarefied gasdynamics during the period Sept. 1960 to Aug. 1962 are reported in summary. Most of these constitute continuation of work reported previously, particularly in the experimental studies of rarefied gasdynamics and the attendant development of equipment experimental tools. New activities have been mainly in the general area of plasmadynamics which is distinguished from magnetohydrodynamics in that the gas in question is only partially ionized and the electrical conductivity is far from approaching infinity. This represents a direction towards treating realistic problems, some of which are of engineering interest, such as the re-entry radio communication problem. (Contractor's abstract)

2759

Southern California U. Engineering Center, Los Angeles.

VISCOUS COMPRESSIBLE AND INCOMPRESSIBLE FLOW IN SLENDER CHANNELS, by J. C. Williams, III. [1962] [10]p. incl. diagrs. refs. (AFOSR-J481) (AF 49(638)-831) AD 408215 Unclassified

Also published in AIAA Jour., v. 1: 186-195, Jan. 1963.

An analytical study is made of viscous flow in slender channels. Similar solutions to the approximate equations of motion, valid for flow at moderate or high Reynolds numbers in slender channels, are found for incompressible 2-dimensional and axisymmetric flows and for compressible flows through 2-dimensional channels with adiabatic walls. A study of compressible flows in convergent-divergent channels yields results regarding the effect of viscosity on the location of the sonic line, on the pressure ratio at the geometric throat and on the discharge coefficient for such channels. (Contractor's abstract)

2760

Southern California U. Engineering Center, Los Angeles.

OPERATIONAL CHARACTERISTICS OF A CRYOPUMP USED IN A LOW-DENSITY WIND TUNNEL, by J. G. Everton. [1962] [5]p. incl. illus. diagrs. tables. [AF 49(638)831] Unclassified

Published in 1962 Trans. Ninth Nat'l. Vacuum Symposium, Los Angeles, Calif. (Oct. 31-Nov. 2, 1962), ed. by G. H. Bancroft. New York, Macmillan Co., 1962, p. 227-231.

While the original cryopump fell short of expected performance, the experience gained from it led to a relatively simple modification which has recently been accomplished and which has multiplied the operational capability several fold. This paper discusses: (1) the design and operation of the original cryopump, (2) the modification of the pump, and (3) operational characteristics subsequent to the modification.

2761

Southern California U. [Engineering Center] Los Angeles.

FREE-MOLECULE FLOW FIELD OVER A FLAT PLATE (Abstract), by H. T. Yang. [1962] [1]p. [AF AFOSR-63-55] Unclassified

Presented at meeting of the Amer. Phys. Soc., Oklahoma U., Norman, Nov. 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 497, Aug. 28, 1963.

The flow field over a finite flat plate shorter than the free-stream mean free path is studied in detail. The discontinuous 2-stream molecular-distribution function and the line-of-sight principle are employed. In the particular case of no free-stream motion, any circular arc subtending the plate as its chord is a constant-density line. This result is independent of the form of the distribution function and may be verified experimentally by density visualization over a thin film heated or cooled in a low-density chamber. Assuming 2-stream Maxwellian distribution, density, velocities, stresses, temperature, and heat fluxes for the entire flow field are obtained. They are expressed, with free-stream speed ratio (Mach number) and plate to free-stream speed ratio as parameters, in the form of infinite series. These flow quantities reduce to conventional free-molecule results on the plate and approach correct free-stream values away from the plate. Numerical examples are worked out on Honeywell-800 and IBM-7090 digital computers.

2762

Southern California U. [Engineering Center] Los Angeles.

HYPERSONIC WAKE MEASUREMENTS BEHIND A SPHERE AT VERY LOW REYNOLDS NUMBERS (Abstract), by R. L. Chuan. [1962] [1]p. [AF AFOSR-63-55] Unclassified

Presented at meeting of the Amer. Phys. Soc., Oklahoma U., Norman, Nov. 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 497, Aug. 28, 1963.

Pitot pressure profiles taken in the wake of a small sphere (0.583 in. diam) show the strong influence of viscous interaction (such as is evident in hypersonic flow around the leading edge of a body), which obliterates the classical near-wake structure of expansion and recompression. The experiments are performed under 2 sets of conditions: (1) moderate density, with Mach number 5.5, Reynolds number (based on sphere diam) 585, and (2) low density, with Mach number 8.5, Reynolds number 105. In the former case, the recompression shock in the near-wake is barely discernible. In the latter case, for which the Knudsen number based on the sphere diameter is 0.35, there is no distinct shock structure around and behind the sphere. Measurements within a few diameters of the sphere suggest that the analytical model of a void swept by the sphere and being refilled after the passage of the sphere is probably fairly good. The pitot pressure on the center line is nearly zero just behind the sphere; and rises to 42% of the free-stream value at 16.5 diameters downstream, decreasing very slowly thereafter. This contrasts with the high-density case (measured by McCarthy) where the pitot pressure on the center line rises to 24% of free-stream value. The growth of the half-width wake appears to be expressed by $Y_w/D = D/2 + (\chi/D)^{0.5}$, where D is the diameter of sphere χ is measured from the center of the sphere.

2763

Southern California U. [Engineering Center] Los Angeles.

PRELIMINARY MEASUREMENTS OF THE FLOW CHARACTERISTICS THROUGH A CONVERGENT-DIVERGENT NOZZLE IN THE TRANSITION REGIME (Abstract), by F. O. Smetana. [1962] [1]p. [AF AFOSR-63-55] Unclassified

Presented at meeting of the Amer. Phys. Soc., Oklahoma U., Norman, Nov. 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 500, Aug. 28, 1963.

In an effort to understand the low-density gas-flow phenomena in a convergent-divergent nozzle in order to determine whether lower operating limits of such nozzles do in fact exist, measurements were made of the variation of the discharge coefficient with Reynolds number and over-all pressure ratio. A limited amount of data on the variation of the ratio of the throat pressure to the upstream-reservoir pressure with upstream-reservoir pressure for maximum mass flow was also obtained. The results of these measurements indicated that, while the characteristics at the continuum end were well-understood and those at the free molecule end could be explained at least qualitatively, the characteristics in the transition regime remain difficult to interpret quantitatively.

2764

Southern California U. [Engineering Center] Los Angeles.

REPLY TO COMMENTS OF PIETER SCHRAM, by T. Koga. [1962] [2]p. [AF AFOSR 63-55] Unclassified

Published in Phys. Fluids, v. 6: 454-455, Mar. 1963.

The author admits that Schram's criticism of his Fokker-Planck analysis (see P. Schram, Phys. Fluids, v. 6: 453-454, Mar. 1963) is correct. A brief discussion of particle correlations is given, followed by another attempt to describe multiple interactions.

2765

Southern Methodist U. Dallas Seismological Observatory, Dallas, Tex.

MACHINE COMPUTATION OF EARTHQUAKE HYPOCENTERS, by E. Herrin, J. Taggart, and C. F. Brown, Jr. [1962] [28]p. incl. tables, refs. (AFOSR-4380) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-137 and National Science Foundation) AD 295947 Unclassified

Also published in Jour. Grad. Research Center, v. 30: 79-106, July 1962.

Machine computation of hypocenters using the method of least squares not only provides a relatively inexpensive means for studying earthquakes in time and space, but also provides large quantities of station residuals all computed according to the same procedure and thus well suited to statistical analysis. Studies of individual station corrections and regional differences in travel times require such data. Provision was made for the use of up to 200 station arrival-times in the computation. Constants for the various stations, together with the travel-time tables, are stored either on punched paper tape or magnetic tape, and may be selected by the operator as desired. All of the solutions given in this paper were obtained using the Jeffreys-Bullen travel times. The computer program is similar to that described by Bolt. Notable differences exist, however, in the weighting of the residuals, the means by which the equations of condition are set up, and in the calculation of focal depths. A brief outline of the computer program is given. (Contractor's abstract)

2766

Southern Methodist U. Dallas Seismological Observatory, Dallas, Tex.

USE OF FOCAL DEPTH DETERMINATIONS IN DISTINGUISHING UNDERGROUND BLASTS FROM EARTHQUAKES, by E. Herrin and J. Taggart. Final rept. Dec. 1962 [52]p. incl. diagrs. tables. (AFOSR-4942) (AF AFOSR-61-137) AD 402752 Unclassified

The first step in the determination of depth of focus is to compute accurately the epicenter of the event in question. A study of the accuracy of various techniques for locating epicenters has revealed that regional variations in Pn velocities must be considered when travel paths of less than 2000 km are to be used in the computation. Because stations at near distances from the epicenter are most useful in determining focal depths, careful studies of regional velocities are necessary to this research project, along with the development of new computer techniques allowing for regional variations in seismic travel times. The results of this type of research along with other projects are included in the report. Two technical papers referred to in the report are included in an appendix while several others, either published or in press, are summarized here.

2767

Southern Methodist U. Dallas Seismological Observatory, Dallas, Tex.

REGIONAL VARIATIONS IN Pn VELOCITY AND THEIR EFFECT ON THE LOCATION OF EPICENTERS, by E. Herrin and J. Taggart. [1962] [10]p. incl. diagrs. tables, refs. (AF AFOSR-61-137) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 52: 1037-1046, Dec. 1962.

Evidence from recent earthquakes and explosions is presented showing substantial regional variations in the velocity of Pn in the U. S. These variations have a significant effect on the location of epicenters by the least-squares-method. A contour map of Pn velocity in the United States is included. A new method for computer location of epicenters is described, and is shown to decrease the error of location for events in the western United States by as much as an order of magnitude. (Contractor's abstract)

2768

Southern Research Inst., Birmingham, Ala.

THE CATION TRANSFERENCE NUMBER IN AQUEOUS POTASSIUM CHLORIDE AT 70 TO 115°, by J. E. Smith, Jr. and E. B. Dismukes. [1962] [2]p. incl. diagr. table, refs. (AFOSR-J725) (AF 49(638)810) Unclassified

Also published in Jour. Phys. Chem., v. 67: 1160-1161, May 1963.

The electric resistance method was used to determine the transference number of potassium ion in approximately 0.1N KCl in the temperature range of 70-115°C. Results are presented in table form. From the range of temperatures for which data are now available, KCl departs from the usual behavior of electrolytes to show transference numbers that become more clearly equal as the temperature increases.

2769

Space Recovery Systems, Inc., El Segundo, Calif.

STUDY OF SOFT RECOVERY FROM TWO-STAGE

VEHICLES, by G. G. Schurr. Jan. 1962, 78p. incl. illus. tables, refs. (AFOSR/IDRA-62-2) (AFOSR-2333) (AF 29(600)2925) AD 272857 Unclassified

Possible recovery methods for vertically reentering payloads released from 2-stage boosers are investigated and discussed. Reentry trajectories including deceleration and heating rates were calculated for a series of reentry velocities and ballistic parameters. The influence of drag variation during reentry on peak deceleration and heating rates is investigated. A recovery method using a variable area drag brake (flexibrake), a parachute system and aerial snatch by helicopter was selected as the most suitable system for recovery of a payload released from a booster consisting of an XM-33 rocket as first stage and an ABLX 244 rocket as second stage. The flexibrake will limit the max deceleration to 15 G and the max deceleration onset rates to 300 G/sec. Attitude stabilization of the payload during the entire flight is maintained by a hydrogen peroxide attitude control system. Preliminary weights and volumes for the payload and recovery vehicle were estimated. (Contractor's abstract)

2770

Sperry Rand Corp. Univac Div., Philadelphia, Pa.

OPTIMIZATION AND STANDARDIZATION OF INFORMATION RETRIEVAL LANGUAGE AND SYSTEMS, by E. G. Fossum, G. Kaskey and others. Final rept. July 1962, 27p. incl. diagrs. tables. (AFOSR-3126) (AF 49(638)835) AD 273177 Unclassified

A series of studies and analyses pertaining to that part of the overall information (document) retrieval function concerned with the storage and maintenance of the master "index" file and the processing of search requests against it is being conducted. This report presents the results of work over the past 2 yrs. (Contractor's abstract)

2771

Stanford Research Inst., Menlo Park, Calif.

THE LOGIC OF AN APPROACH TO THE ANALYSIS OF COMPLEX SYSTEMS, by K. H. Schaeffer. Apr. 1962, 42p. incl. refs. (AFOSR-2136) (AF 49(638)-1020) AD 275534 Unclassified

In an attempt to evolve a general method for systems analysis, a possible approach to the analysis of complex man-machine systems is discussed. This approach assumes that systems can be divided into elements and their direct relations, where the elements include the components and the processes of the system, as well as the factors external to the system which determine it. The elements and direct relations are used to construct a representative network of the system. The system is then analyzed by means of one or more mathematical models. These models are evaluated against the network for their completeness in representing the system. Elements and direct relations which were not modeled or were only inadequately modeled are then described by less formal means. In the final step, the mathematical models and the additional descriptions are judgmentally integrated by the analyst. (Contractor's abstract, modified)

2772

Stanford Research Inst., Menlo Park, Calif.

AUGMENTING HUMAN INTELLECT: A CONCEPTUAL FRAMEWORK, by D. C. Engelbart. Summary rept. Oct. 1962, 134p. incl illus. diagrs. refs. (AFOSR-3223) (AF 49(638)1024) AD 289565 Unclassified

A detailed conceptual framework explores the nature of the system composed of the individual and the tools, concepts, and methods that match his basic capabilities to his problems. One of the tools that shows the greatest immediate promise is the computer, when it can be harnessed for direct on-line assistance, integrated with new concepts and methods. (Contractor's abstract)

2773

Stanford Research Inst., Menlo Park, Calif.

A PRELIMINARY INVESTIGATION AND ANALYSIS OF THE ROLE OF SCIENTISTS IN RESEARCH ORGANIZATIONS, by H. M. Vollmer. Feb. 1962, 173p. incl. illus. diagrs. tables, refs. (Technical rept. Phase 1) (AFOSR-2545) (AF 49(638)1028) AD 275937 Unclassified

A review of past studies provided the basis for a conceptual representation of elements commonly included in the role of a scientist in a research organizaztion. Analysis of survey data indicated differences and similarities in specific role expectations of research scientists in an industrial research laboratory versus other types of employees in a variety of organizations. Comparison of findings from this survey with findings from 2 other studies suggests that situational variations in the context of employment may have considerable effect upon scientists' expectations regarding relations with supervision, career advancement opportunities, and salary considerations. The importance that scientists attach to intellectual challenge in their work and to professional status among colleagues appears to be more constant, regardless of variations in organizational environment. (Contractor's abstract)

2774

Stanford Research Inst., Menlo Park, Calif.

VISUAL INFORMATION PROCESSING IN INSECTS, by J. C. Bliss. Summary rept. Oct. 14, 1961-Oct. 14, 1962. Nov. 1962, 42p. incl. illus. diagrs. tables, refs. (Technical rept. no. 1) (AF 49(638)1112) AD 414386 Unclassified

This report describes mathematical analysis, behavior experiments, and neurophysiological experiments aimed at determining the mechanisms of visual perception in insects. The behavioral experiments with the beetle Limus indicate that spatial processing involving

autocorrelation is being performed among the ommatidia of the eye. This processing was studied by means of an optomotor reaction involving a turning tendency with movement in the visual field. Visual processing in the beetle Lixus was also studied by means of microelectrode recording of electrical nervous activity. The electroretinogram (ERG) was measured for various visual stimuli and Bode diagrams were determined for small changes in light intensity. Nonlinear effects were also noted for large channels in light intensity. Spike potentials were obtained from a single cell which fired with a change in light intensity. Spike potentials were also obtained from the ventral nerve cord, anterior thoracic region, and motor nerve stump of the first joint of the right front leg. A functional model is proposed to explain the behavioral and neurophysiological results. (Contractor's abstract)

2775

Stanford Research Inst. [Poulter Labs.] Menlo Park, Calif.

STUDY OF ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS, by G. A. Agoston and G. M. Muller. Narrative progress rept. no. 13, Jan. 1-Mar. 31, 1962, 9p. incl. illus. diagrs. (Sponsored jointly by Advanced Research Projects Agency; and Air Force Office of Scientific Research under AF 49(638)565) AD 609891
Unclassified

Progress in the following areas is summarized: acoustic admittance of a standard sample, instrumentation for burning propellant tests, initial burning propellant experiments, obtaining the true admittance of a burning surface, and spectral change in a plane acoustic pulse of finite amplitude. (Contractor's abstract)

2776

Stanford Research Inst. [Poulter Labs.] Menlo Park, Calif.

STUDY OF ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS, by G. A. Agoston and G. M. Muller. Narrative progress rept. no. 14, Apr. 1-June 30, 1962, 5p. incl. illus. diagrs. (Sponsored jointly by Advanced Research Projects Agency; and Air Force Office of Scientific Research under AF 49(638)565) AD 609892
Unclassified

Progress is reported on admittance measurements of cold samples by the reflected pulse method, and burning propellant experiments. (Contractor's abstract)

2777

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

CONCEPTS OF SHOCK WAVE PROPAGATION, by G. E. Duvall. [1962] [25]p. incl. diagrs. refs. (AF 49(638)-1086) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 52: 869-893, Oct. 1962.

Those aspects of shock wave propagation which differ qualitatively from linear wave propagation are discussed and illustrated. These include amplitude attenuation, energy dissipation and their interrelations, spectral intensity distribution and its variation with distance, and the relations of wave structure to thermodynamic, shear, and time-dependent material properties. Pertinent formulae are derived and calculations are given for a rigid-locking solid. These illustrate the concentration of energy at low frequencies as the wave progresses and provide upper limits for the rates of attenuation peak shock pressure in plane and spherical geometries.

2778

Stanford U. Applied Mathematics and Statistics Labs., Calif.

ALGEBRAS OF DIFFERENTIABLE FUNCTIONS, by K. de Leeuw and H. Mirkil. [1962] [5]p. (In cooperation with Dartmouth Coll.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-294 and AF 49(638)812, and National Science Foundation)
Unclassified

Published in Bull. Amer. Math. Soc., v. 68: 411-415, July 1962.

Let C_0 be the space of all complex-valued continuous functions on the plane which vanish at infinity, and let D be the subcollection of functions with compact support. Let A be a finite set of differential operators $\Sigma a_{mn} \partial^{m+n}/\partial x^m \partial y^n$ with constant coefficients. Let $C_0(A)$ be the completion of D under the set of semi-norms $\|f\|_\infty$, $\|Bf\|_\infty$, $B \in A$, with each indicated norm as the sup norm. Each $C_0(A)$ is invariant under translation. Certain subspaces $C_0(A)$ are also invariant under all rotations of the plane; namely, $C_0^N = \{f \in C_0 | f$ has derivatives of all orders less than or equal to N in $C_0\}$, and $C_0^\infty = \cap_N C_0^N$. If A is a proper subset of $\{\partial^{m+n}/\partial z^n \partial \bar{z}^m;\ m + n = N\}$, then $C_0(A)$ is invariant under rotations and is distinct from any of the above mentioned invariant spaces. Moreover, distinct subsets A give distinct $C_0(A)$. Furthermore, each rotation-invariant subcollection distinct from the C_0^N and C_0^∞ is given by an N and an A as above. If the sup norm is replaced throughout by the L_p norm, $1 < p < \infty$, there are no analogues of the $C_0(A)$ in the prior paragraph. Analogous results are also stated for algebras of functions on Riemann surfaces in relation to conformal equivalences between such surfaces. No proofs are given for any of the results that are stated. (Math. Rev. abstract)

2779

Stanford U. [Applied Mathematics and Statistics Lab.] Calif.

ANALYTIC MEASURES ON COMPACT GROUPS, by K. de Leeuw and I. Glicksberg. [1962] [5]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)294] and National Science Foundation) Unclassified

Published in Bull. Amer. Math. Soc., v. 69: 46-50, Jan. 1963. (Title varies)

An extension to compact abelian groups of the theorems of F. and M. Riesz is obtained, concerning analytic measures on the circle group. Let G be a compact abelian group, and let Γ be its dual group. Let γ be a non-trivial homomorphism of Γ into the reals R, and let φ be the continuous dual homomorphism of R into G. Several notions are defined relative to φ. A regular Borel measure μ is called quasi-invariant under φ if the collection of Borel sets E with $|\mu|(E) = 0$ is invariant under translation by elements of $\varphi(R)$. A measure μ (or function f) on G is called φ-analytic if $\hat{\mu}(\gamma) = 0$ ($\hat{f}(\gamma) = 0$) for all γ such that $\xi(\gamma) < 0$. Call a subset E of G null [thick] in the direction of φ if for each $x \in E$ $\{t \in R | x + \varphi(t) \in E\}$ has zero [positive] Lebesgue measure. Call a measure μ on G non-vanishing in the direction of φ if $|\mu|(E) > 0$ for each Borel subset E of G that is thick in the direction of φ and for which $|\mu|(E + \varphi(R)) > 0$. Finally, call μ on G absolutely continuous in the direction of φ if $\mu(E) = 0$ for all Borel sets E which are null in the direction of φ. The principal result, which is used to obtain the other results, is that if μ is a φ-analytic measure on G, then μ is quasi-invariant under φ. The extension of the first of the F. and M. Riesz theorems is that if μ is a φ-analytic measure on G, then μ is absolutely continuous in the direction of φ. The following result is an extension of a result of Rudin for the circle group: If E is a closed subset of G, then E is null in the direction of φ if and only if to each continuous function h on E there is a continuous φ-analytic function f on G which is an extension of h. The extension of the second theorem of F. and M. Riesz states that if μ is a φ-analytic measure on G, then μ is non-vanishing in the direction of φ. It is also shown that $\varphi(R)$ is dense in G and μ is a φ-analytic measure on G that either vanishes on an open subset of G or is absolutely continuous and vanishes on a Borel set of positive Haar measure, then μ is the zero measure. Modifications are indicated to show that the principal theorems are also valid for G locally compact. (Math. Rev. abstract)

2780

[Stanford U. Applied Mathematics and Statistics Lab. Calif.]

FUNCTION ALGEBRAS WITH CLOSED RESTRICTIONS, by I. Glicksberg. [1962] [4]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)294] and National Science Foundation) Unclassified

Published in Proc. Amer. Math. Soc., v. 14: 158-161, Feb. 1963.

Let C(X) be the algebra of all complex continuous functions on the compact Hausdorff space X and let C(X) have the supremum norm. Let A be a closed subalgebra of C(X) which contains the constants and which separates the points of X. For any closed subset F of X, let $A|F$ be the subalgebra of C(F) formed by the restrictions of the elements of A to F. The author proves that if $A|F$ is a closed subalgebra of C(F) for each closed subset F of X, then A = C(X). (Math. Rev. abstract)

2781

[Stanford U. Applied Mathematics and Statistics Lab., Calif.]

MEASURES ORTHOGONAL TO A DIRICHLET ALGEBRA, by I. Glicksberg and J. Wermer. [1962] [6]p. [AF 49-(638)294] Unclassified

Published in Duke Math. Jour., v. 30: 661-666, Dec. 1963.

Let A be a Dirichlet algebra and μ a measure in $A|$. Then there exists an at most countable set of positive measures λ_i, for each i some k_i in $H_0^1(\lambda_i)$, and a measure σ in $A|$ which is singular with respect to all possible multiplicative measures, so that $\mu = \sigma + \Sigma k_i \lambda$, with the series converging in total variation. If A is the algebra of uniform limits of polynomials on A compact subset X of the plane, each point of which is in the boundary of the unbonded component of the complement of X, then always $\sigma = 0$. (Math. Rev. abstract)

2782

Stanford U. Applied Mathematics and Statistics Labs., Calif.

SOME CURRENT DEVELOPMENTS IN MODELS OF LEARNING FOR A CONTINUUM OF RESPONSES, by P. Suppes. [1962] [9]p. incl. diagrs. refs. (AFOSR-64-1035) (AF 49(638)1037) AD 440960 Unclassified

Presented at AIEE Joint Automatic Control Conf., New York, June 27-29, 1962.

Also published in I. E. E. E. Trans. on Appl. and Indus. v. 83: 297-305, Sept. 1964.

Within experimental psychology, models of learning for a continuum of responses have not as yet been developed to as high a degree as models which are restricted to a finite number of responses. For a continuum of responses, the assumption of conditioning to exactly 1 response is psychologically unrealistic and mathematically awkward. The assumption was previously introduced that the conditioning of each stimulus is smeared over a certain interval of responses, and the conditioning of any stimulus is represented by a smearing distribution. At present, it seems that a better argument can be made in terms of ideas of response generalization. However, it should be emphasized that the derivation of the

smearing distribution from more primitive or fundamental psychological ideas has not yet been completed in detail in any satisfactory form. The axioms of this theory are formulated verbally but with some attempt to convey a sense of formal precision. It is not difficult to convert them into a mathematically exact form, they fall naturally into 3 groups First, the conditioning axioms are stated, then the sampling axioms, and finally the response axioms.

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Stanford U. [Applied Mathematics and Statistics Lab.] Calif.

SOME DIFFERENTIAL EQUATIONS OF THE MATHIEU TYPE, AND RELATED INTEGRAL EQUATIONS, by G. E. Latta [1962] [8]p. (AFOSR-J1266) (AF 49(638)-1045) AD 424343 Unclassified

Also published in Jour. Math. Phys., v. 42: 139-146, June 1963.

This paper presents some eigenvalue problems for equations of the Mathieu type and shows that the solutions satisfy corresponding integral equations, similar to Whittaker's integral equation for the Mathieu functions. It also deals with a similar eigenvalue problem for a system of 2 first order equations, the solutions of which solve the problem of the diffraction of a plane wave by a slit. An equivalent pair of integral equations for the solutions is constructed, and the solution of the eigenvalue problem is discussed at some length.

2784

Stanford U. [Applied Mathematics and Statistics Lab.] Calif.

ON THE MARTIN BOUNDARY FOR MARKOV CHAINS, by K. L. Chung. [1962] [6]p. (AFOSR-3832) (AF AFOSR-62-243) Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 963-968, June 1962.

A continuous parameter Markov chain $\{x(t), t \geq 0\}$ with stationary transition probability $p_{ij}(\cdot)$ is considered. It is supposed that $-\infty < p_{ii}'(0)$, $\Sigma_j p_{ij}'(0) = 0$ and that the states are transient. If a is the time to the first infinite discontinuity, let $y(t) = x(a-t)$, defined when $a \geq 1$. The y(t) process is a Markov chain, and its absolute and (stationary) transition probabilities are evaluated explicitly. A Martin-type boundary is defined by the convention that the sequence of states (integers) $\{j_k, k \geq 1\}$ converges to a boundary point if $j_k \to \infty$ and if (*) $\lim_{k\to\infty} P\{y(a) = i | y(t) = j_k\}$ exists for all i. (The indicated conditonal probability does not depend on t). A second boundary definition is also suggested, in which y(a) in (*) is replaced by y(s). The conditional probability is then a function of $t - s$ (> 0), and the limit is to exist for all $t - s$, i. (Math Rev. abstract, modified)

2785

Stanford U. Applied Mathematics and Statistics Lab., Calif.

ON THE DISTRIBUTION OF A "CLOSENESS" CRITERION, by T. Cacoullos. May 9, 1962, 17p. (Technical rept. no. 75) (AFOSR-2718) (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research and [Signal Corps] under Nonr-22552) Unclassified

The classification approach is realistic in many taxonomic problems, where the possibilities are limited to two. However, when the external evidence is slight or in case the populations are clearly distinct but still overlapping, like the example of a modern language and 2 relatively older ones where the actual question is which older language is nearer to the modern language, then the question of which is the nearer is quite pertinent and realistic. The problem in the topothetical approach is the choice of an "appropriate" measure of distance between 2 populations. For the case of multivariate normal populations with the same covariance matrix, the Mahalanobis generalized distance seems a natural measure of the divergence between them. In a more general distance function the statistic d is introduced in the form of a non-central bilinear form in normal variates; then, it is reduced to a difference of independent non-central quadratic forms in normal variates. The method of mixtures developed by Robbins and Pitman is employed to yield the distribution function of d as a mixture of distribution functions of differences of independent chi-square variables.

2786

Stanford U. Applied Mathematics and Statistics Lab., Calif.

AVERAGE RENEWAL LOSS RATES, by M. V. Johns, Jr. and R. G. Miller, Jr. May 18, 1962, 11p. incl. refs. (Technical rept. no. 76) (AFOSR-2719) (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research and [Signal Corps] under Nonr-22552) Unclassified

The appropriate index of merit for decision procedure is the "average" profit (or loss) per unit time (or per item) for a large number of cycles. The notion of "average" profit rate can be mathematically defined in 4 distinct and apparently equally plausible ways, and it is the purpose of this note to show that the various definitions are not necessarily equivalent and to determine the conditions under which they are equivalent.

2787

Stanford U. Applied Mathematics and Statistics Lab., Calif.

A COMPARISON OF QUEUE DISCIPLINES WHEN SERVICE ORIENTATION TIMES OCCUR, by D. P. Gaver, Jr. July 5, 1962 [30]p. incl. diagr. tables,

refs. (Technical rept. no. 79) (AFOSR-3157) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) Unclassified

Situations in which customers belonging to 2 (or more) different classes vie for service at a single facility can be identified in various fields of application. For example, a machine tool may be used to produce any one of a variety of parts, a computer will be used for a number of different kinds of basic computations, a repairman or operator may be responsible for a number of machines, etc. When such versatility is required of the server, it is not surprising to find that the latter sometimes requires a time, in addition to the usual time, in order to accomplish each individual task. This time is the orientation time required whenever the server must turn attention from members of one class of customers to those of another. Queue disciplines are presented.

2788

Stanford U. Applied Mathematics and Statistics Lab., Calif.

ACCOMMODATION OF SECOND-CLASS TRAFFIC, by D. P. Gaver, Jr. Feb. 26, 1962, 28p. (Technical rept. no. 74) (AFOSR-3181) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) Unclassified

Various situations seem to give rise to traffic problems of the following sort: a service facility exists for a certain primary function, but not always busy performing it thus gaps exist between periods of primary function performance. The gaps are thus available for some secondary tasks, the performance of which must not disturb the facility's primary activity; the traffic composed of such tasks may be called second-class. Thus opportunities exist for performance of low-priority tasks in what would otherwise be idle periods. The quality of the resulting service to the tasks is investigated.

2789

Stanford U. [Applied Mathematics and Statistics Lab.] Calif.

STATIONARITY EQUATIONS IN CONTINUOUS TIME MARKOV CHAINS, by R. G. Miller, Jr. [July 27, 1962] [18]p. incl. refs. [Technical rept. no. 80] (AFOSR-4212) (Sponsored jointly by [Air Force Office of Scientific Research], Office of Naval Research, and [Signal Corps] under Nonr-22552) AD 282910 Unclassified

Also published in Trans. Amer. Math. Soc., v. 109: 35-43, Oct. 1963.

The author considers an irreducible Markov chain with a countable infinity of states in continuous time; honesty of the (standard) matrices P(t) is not insisted on, but it is assumed that all states are stable and that the Q-matrix is conservative. The positive solutions to the equations (*) $yQ = 0$ is investigated. It is noted that the following false theorem is often assumed: "The existence of a convergent positive solution to (*) is a necessary and sufficient condition for positive recurrence, and when one exists, it is unique up to a constant multiplier and coincides with $y_i = \lim p_{ii}(t)$ $(t \to \infty)$". However, the false statement is true if it be assumed that the process is uniquely determined by its Q-matrix (i.e., if the "minimal" process is "honest"). There is then, in addition, an analogue to Derman's theorem about recurrent chains: Recurrence implies that (*) has a positive solution which is unique up to a multiplying constant (the author determines this unique solution in terms of "taboo" probabilities). The paper concludes with remarks about the imbedded Markov chain, and examples illustrating the pathology of the transient case. (Math. Rev. abstract, modified)

2790

Stanford U. Applied Mathematics and Statistics Lab., Calif.

A CONVERGENT ASYMPTOTIC EXPANSION FOR MILL'S RATIO AND THE NORMAL PROBABILITY INTEGRAL IN TERMS OF RATIONAL FUNCTIONS, by H. Ruben. June 8, 1962, 20p. incl. refs. (Technical rept. no. 78) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 277106 Unclassified

Also published in Math. Ann., v. 151: 355-364, June 1963.

Let Mill's ratio be defined by $R(x) = [1-\Phi(x)]/\phi(x)$, where $\phi(x)$ and $\Phi(x)$ are the standardized normal density and distribution function. Using results in asymptotics due to J. Franklin and B. Friedman, the author obtains a series expansion $R(x) = \Sigma_{k=0}^{\infty} g_k(x)$, both asymptotic and convergent for $x > 0$, where $g_k(x)$ are rational functions given by expressions too lengthy to be reproduced here. A recursive method is presented for computing the $g_k(x)$, and upper bounds are obtained for the truncation errors $R(x) - \Sigma_{k=0}^{n-1} g_k(x)$. (Math. Rev. abstract)

2791

Stanford U. Applied Mathematics and Statistics Lab., Calif.

ESTIMATING MISSILE RELIABILITY, by S. Blumenthal and J. Denton. Oct. 26, 1962, 17p. (Technical rept. no. 81) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 291603 Unclassified

The probability that a missile will destroy its assigned target is studied based on estimations of missile reliability. It is desirable that each target upon which missiles are expended should have enough missiles allocated to it so that its survival probability is very small. However, we wish to avoid assigning more missiles than necessary to a given target. Nevertheless, a given

amount of over-assignment is to be preferred to the same amount of under-assignment, i. e., in terms of a non-negative loss function, the loss is zero when the target does not survive and positive otherwise. (Contractor's abstract)

2792

Stanford U. Applied Mathematics and Statistics Lab., Calif.

ON A PSEUDO-SOLUTION TO A SCHEDULING PROBLEM, by S. Zacks. Dec. 14, 1962, 15p. incl. table. (Technical rept. no. 84) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 294126 Unclassified

The scheduling problem considered is relatively simple. All the operations were considered as equally important, and it was assumed that each of the operations could be performed at any time uninterruptedly. In reality, most of the scheduling problems are more complicated. Some operations often require priority over other operations in the sense that they are more profitable or a higher utility weight is attached to them. In these cases, the scheduling problem might be more complicated, since there are more restrictions in the case of priorities, and more freedom of choice in the case of discontinuous operations. Yet, no way of finding a general optimal solution, which is short of complete enumeration, was established. Pseudo-solutions, based on an extra assumption concerning the dependence structure among the earliest starting points of operations, were derived by the method of dynamic programming. (Contractor's abstract)

2793

Stanford U. Applied Mathematics and Statistics Lab., Calif.

OPTIMAL DESIGN OF EXPERIMENTS, by H. Chernoff. Oct. 31, 1962, 15p. incl. diagrs. (Technical rept. no. 82) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 291604 Unclassified

Some aspects of the theory of optimal design of experiments with particular emphasis on its relevance to the practice of statistics are discussed. There are 2 major branches of classical statistics, estimation and testing of hypothesis, for which the theory of optimal design yields different results. This paper is limited to results and examples in the theory of estimation. (Contractor's abstract)

2794

Stanford U. Applied Mathematics and Statistics Lab., Calif.

SEQUENTIAL TESTS FOR THE MEAN OF A NORMAL DISTRIBUTION II (Large t), by J. Breakwell and H. Chernoff. Nov. 27, 1962, 17p. (Technical rept. no. 83) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 294125 Unclassified

Also published in Ann. Math. Stat., v. 35: 162-173, Mar. 1963.

Asymptotic expansions are derived for the behavior of the optimal sequential test of whether the unknown drift μ of a Wiener-Levy process is positive or negative for the case where the process was observed for a long time. The test is optimal in the sense that it is the Bayes test for the problem where there is an a priori normal distribution of μ, the regret for coming to the wrong conclusion is proportional to μ, and the cost of observation is constant per unit time. The Bayes procedure is then compared with the best sequential likelihood ratio test. (Contractor's abstract)

2795

Stanford U. Applied Mathematics and Statistics Lab., Calif.

TWO-PERSON MARKOV GAMES, by G. Elfving. June 1, 1962, 40p. incl. diagrs. table. (Technical rept. no. 77) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 277105 Unclassified

The present analysis deals with sequential 2 person non-zero-sum games in which the players' decisions are based on a fixed number of preceding moves. The decision rules are (in general) independent of time and may include randomization. A notion of social equilibrium is discussed. It applies generally to games where the players are technically in the same position, and a distribution (D) of strategies is required over a population, such that any strategy that appears in D is good against the mixed strategy defined by selecting a strategy in D at random. (Contractor's abstract)

2796

Stanford U. Dept. of Aeronautical Engineering, Calif.

BUCKLING OF A THIN CIRCULAR CYLINDRICAL SHELL HEATED ALONG AN AXIAL STRIP, by N. J. Hoff, C.-C. Chao and W. A. Madsen. Sept. 1962, 16p. incl. diagrs. (SUDAER no. 142) (AF AFOSR-62-146) AD 400282 Unclassified

Presented at West Coast Conf. of the Appl. Mech. Div. of the Amer. Soc. Mech. Engineers, Monterey, Calif., Aug. 26-28, 1963.

Also published in Jour. Appl. Mech., v. 31: 253-258, June 1964.

The elastic stability of a thin-walled circular cylindrical shell is investigated by means of the small-deflection theory when the shell is subjected to such nonuniform heating as causes a uniform axial compressive stress to arise in a band of width 2b while the rest of the shell is free of stress. The critical value of the compressive axial stress is found to be equal to the critical stress of the same circular cylindrical shell when subjected to

uniform axial compression provided the band is not extremely narrow. In the latter case, the critical stress of the band is higher than that of the uniformly compressed shell. (Contractor's abstract)

2797

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A THEORY OF ASYMMETRIC HYPERSONIC BLUNT-BODY FLOWS, by R. J. Swigart. Jan. 1962, 53p. incl. diagrs. table, refs. (SUDAER no. 120) (AFOSR-2232) (AF 49(638)965) AD 274612 Unclassified

Also published in AIAA Jour., v. 1: 1034-1042, May 1963.

The problem of supersonic and hypersonic flow past blunt bodies at small angles of attack is considered. Two-dimensional asymmetric as well as 3-dimensional flow is analyzed. The method of analysis is an inverse one, that is, the shock-wave shape and free stream conditions are known, and the corresponding body shape and flow field are determined. Solutions at zero angle of attack are obtained as a special case of the general problem. Results at zero angle are obtained for shock waves that are portions of circles, parabolas, spheres, and paraboloids of revolution at a free stream Mach number of infinity and ratio of specific heats of 1.4. Results are obtained for parabolic and paraboloidal shock waves at small angle of attack and infinite free stream Mach number. A symmetrical shock wave at angle of attack is produced by a body that is asymmetric to the shock axis of symmetry. However, a conic section may be fitted to the converged body shape out to the sonic point. This is done for the third-truncation body that produces a parabolic shock at angle of attack of 10°. The body is closely approximated by a prolate ellipse at angle of attack of 14.2°. (Contractor's abstract)

2798

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A REVIEW AND EXTENSION OF SECOND-ORDER HYPERSONIC BOUNDARY-LAYER THEORY, by M. Van Dyke. [1962] [16]p. incl. diagrs. refs. (AFOSR-3881) (AF 49(638)965) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 2: 212-227, 1963. (AFOSR-5310)

A critical examination is made of second-order boundary-layer theory as applied to heat transfer at the stagnation point of a sphere in supersonic flow. A constant-density model is constructed, which sheds light on such matters as the displacement effect and the Newtonian approximation. An examination of a number of existing theories shows several to be defective in their treatment of the related effects of external vorticity and displacement. Theoretical calculations are compared with 2 sets of experimental data, showing mediocre agreement for 1 and serious discrepancies for the other. (Contractor's abstract)

2799

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

HIGHER APPROXIMATIONS IN BOUNDARY-LAYER THEORY. PART 2. APPLICATION TO LEADING EDGES, by M. Van Dyke. [1962] [15]p. incl. refs. (AFOSR-J1028) (AF 49(638)965) AD 418295 Unclassified

Also published in Jour. Fluid Mech., v. 14: 481-495, Dec. 1962.

A systematic procedure was developed in part 1 (item no. 2801) for improving upon Prandtl's boundary-layer theory. The second approximation was studied in detail for steady laminar flow of a constant-property fluid past an analytic semi-infinite plane or axisymmetric body free of separation. Five additive second-order effects were identified. Here that analysis is illustrated by application to specific problems. It is natural to consider first the Falkner-Skan family of self-similar flows, which require numerical integration of only ordinary differential equations. The 3 most useful cases are chosen, corresponding to the plane and axisymmetric stagnation point and the flat plate (the first-order solutions being associated with the names of Hiemenz, Homann, and Blasius). Each of these can be taken as the basis of a Blasius series to extend the solution downstream over a body of general shape. That point of view, which is in fact essential in the second approximations for unsymmetric plane flow, is the one adopted here. (Contractor's abstract)

2800

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

[KINETIC THEORY OF THE PHENOMENA OF DISPERSION IN GAS MIXTURES: APPLICATION TO THE CALCULATION OF DISPERSION COEFFICIENTS BY A SIMPLIFIED METHOD] Theorie cinétique des phénomènes de dissipation dans les mélanges de gaz; application au calcul des coefficients de dissipation par une méthode simplifiée, by J. P. Guiraud. [1962] [26]p. incl. diagr. table, refs. (AFOSR-J1040) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-965 and Office National d'Etudes et de Recherches Aeronautiques (France)) Unclassified

Also published in Rarefied Gas Dynamics; Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 1: 226-251, 1963. (AFOSR-5310)

A method of calculating viscosity coefficients, thermal conductivity coefficients, and diffusion rates in gas mixtures is presented. The technique used is analogous to one given by Prigogine and attempts to simplify Chapman's and Cowling's method for determining fluid flow parameters.

2801

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

HIGHER APPROXIMATIONS IN BOUNDARY-LAYER THEORY. PART 1. GENERAL ANALYSIS, by M. Van Dyke. [1962] [17]p. incl. diagr. refs. [AF 49(638)965] Unclassified

Published in Jour. Fluid Mech., v. 14: 161-177, Oct. 1962.

Prandtl's boundary-layer theory is embedded as the first step in a systematic scheme of successive approximations for finding an asymptotic solution for viscous flow at large Reynolds number. The technique of inner and outer expansions is used to treat this singular-perturbation problem. Only analytic semi-infinite bodies free of separation are considered. The second approximation is analyzed in detail for steady laminar flow past plane or axisymmetric solid bodies. Attention is restricted to low speeds and small temperature changes, so that the velocity field is that for an incompressible fluid, the temperature field being calculated subsequently. The additive effects are distinguished of longitudinal curvature, transverse curvature, external vorticity, external stagnation enthalpy gradient, and displacement speed. The effect of changing co-ordinates is examined, and the behavior of the boundary-layer solution far downstream discussed. Application to specific problems will be made in subsequent papers.

2802

Stanford U. Dept. of Chemistry, Calif.

CHEMICAL APPLICATIONS OF NUCLEAR MAGNETIC RESONANCE, by R. A. Ogg, Jr. and D. Ray. Final rept. Jan. 1958-Aug. 1962 [102]p. incl. illus. diagrs. tables, refs. (AFOSR-3473) (AF 49(638)286) AD 603735 Unclassified

This research applies techniques of high resolution nuclear magnetic resonance to obtain information about molecular structure of certain chemical substances and of the changes these undergo during reaction. Several reports and reprints are included. Some of the titles are: (1) Miniature glass heat exchange for the microsecond range; (2) Ambiguities in inorganic nitrogen chemistry; (3) Heat of isomerization of peroxynitrite to nitrate and kinetics of isomerization of peroxynitrous acid to nitric acid; and (4) Structural studies on several nitrogen compounds by N^{14} NMR.

2803

[Stanford U. Dept. of Chemistry, Calif.]

HEAT OF ISOMERIZATION OF PEROXYNITRITE TO NITRITE AND KINETICS OF ISOMERIZATION OF PEROXYNITROUS ACID TO NITRIC, by J. D. Ray. [1960] [7]p. incl. diagrs. (Bound with its AFOSR-3473; AD 603735) (AF 49(638)286) Unclassified

Presented at Southeastern Regional meeting of the Amer. Chem. Soc., Birmingham, Ala. (Nov. 3-5, 1960).

The reaction between hydrogen peroxide and nitrous acid at 0° results in high yields of the rapidly formed intermediate peroxynitrous acid which isomerizes to nitric acid at a slower rate. By stopping the reaction with the addition of base at various times and measuring the total heat evolved in a calorimeter, the rate constant for isomerization of the peroxynitrite ion to the nitrite ion was deduced to be 38.3 ± 2 kcal/mol in dilute aqueous solutions at 1°. (Contractor's abstract)

2804

Stanford U. Dept. of Chemistry, Calif.

[MAGNETIC SPIN-SPIN INTERACTION IN THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF THE TERTIARY BUTYL FORMATE] Interazione magnetica spin-spin nello spettro a risonance nucleari magnetiche del formiato butilico terziario, by R. A. Ogg, Jr., C. Franconi, and J. D. Ray. [1960] [4]p. incl. diagr. (AF 49(638)286) Unclassified

Published in Riv. Scienza e Tecnica, v. 4: 69-72, Nov. 1, 1960.

Tertiary butyl formate was found to have a nuclear magnetic resonance spin-spin coupling across 5 bonds between the methyl and formyl protons of 0.25 cps. The reaction of 1 mol t-butanol with 12.6 mol formic acid to produce t-butyl formate and water was found to have approximately zero heat of reaction with equilibrium constant of 0.21. The azeotrope of alcohol and ester (60%) was found to have a boiling point of 79.3°C.

2805

Stanford U. Dept. of Chemistry, Calif.

AMBIGUITIES IN INORGANIC NITROGEN CHEMISTRY, by J. D. Ray and R. A. Ogg, Jr. [1962] [10]p. incl. refs. (Bound with its AFOSR-3473; AD 603735) (AF 49-(638)286) Unclassified

Examples of inorganic nitrogen chemistry studies which involve violation of 1 or more concepts of the scientific method are discussed in terms of individual types and the ambiguities further clouded or clarified in terms of recent experimental results. Some of the topics discussed are: (1) new compounds make suspect of old kinetic studies, (2) the crystal structure is not necessarily the aqueous phase structure, and (3) assumption as to the isomeric structure is erroneous.

2806

Stanford U. Dept. of Chemistry, Calif.

HYPONITRITE, α OXYHYPONITRITE AND NITROXITE: STRUCTURES AND REACTIONS, by J. D. Ray and R. A. Ogg, Jr. [1962] [9]p. incl. diagrs. tables, refs. (Bound with its AFOSR-3473; AD 603735) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)286, National Science Foundation, and Research Corp.) Unclassified

It might seem that the structure of hyponitrite in solution could be deduced to be the same as for the crystalline salt. However, many chemical reactions do not seem capable of explanation on the basis of this structure. It was suggested by Audrieth that hyponitrous acid may be described best as nitrosohydroxylamine. Evidence presented in this paper is in agreement with this hypothesis.

2807

Stanford U. Dept. of Chemistry, Calif

A NEW RAPID SYNTHESIS OF SODIUM HYPONITRITE, by J. D. Ray and R. A. Ogg, Jr. [1962] [6]p. (Bound with its AFOSR-3473; AD 603735) (Sponsored jointly by Air Force Office of Scientific Research under AF 49 (638)286 and Georgia Technology Foundation) Unclassified

Silver hyponitrite has been prepared in 15% yield by adding yellow mercuric oxide to a solution .23 H in hydroxylamine (as the sulfate) and 3 H in NaOH. After filtration, $Ag_2N_2O_2$ is precipitated from the neutralized solution. The silver salt is acidified with H_2SO_4, extracted with ether and the anhydrous sodium salt precipitated by addition of sodium methoxide. (Contractor's abstract)

2808

Stanford U. Dept. of Chemistry, Calif.

STRUCTURAL STUDIES ON SEVERAL NITROGEN COMPOUNDS BY N^{14} NMR, by D. P. Hollis. Doctoral thesis [1961] [27]p. incl. illus. diagrs. table, refs. (AF 49(638)286) Unclassified

Through a study of the proton and nitrogen NMR spectra of diethylcyanamide and N,N'-dicyclohexylcarbodiimide, the structure $R_2N\text{-}C{\equiv}N$ and R-N=CN-R have been shown to apply to cyanamides and carbodiimides respectively. Apparatus has been developed and constructed for the observation of N^{14} NMR in low-boiling liquids and spectra have been obtained for N_2O and N_2 liquids. N^{14}-N^{14} spin-spin coupling has been reported for the first time. N^{14} resonance has been observed in free hyponitrous acid, and the spectrum is shown to indicate a symmetrical structure for hyponitrous acid.

2809

Stanford U. Dept. of Chemistry, Calif.

ON THE MORPHOLOGY OF THE CRYSTALLINE STATE IN POLYMERS, by P. J. Flory. [1962] [11]p. incl. diagrs. refs. [AF AFOSR-62-131] Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 2857-2867, Aug. 5, 1962.

Geometrical and spatial requirements for the accommodation of polymer chains in random conformations set an upper limit of $v_2 A_c/2A_a$ on the fraction of those chains emerging from the face of a lamellar crystallite of large lateral dimensions which may traverse the interfacial zone and vanish into the surrounding disordered region without returning to the crystallite; v_2 is the volume fraction of polymer in the surrounding phase; and A_a and A_c are the cross sections occupied by the polymer chain in its amorphous and crystalline conformations, respectively. A considerable fraction of the chains emanating from the crystal face may escape the environs of the crystal without returning. Those which return need not adopt the folded pattern currently assumed. Helical conformations, increase the crystalline chain cross section and thus alleviate the crowding of chains otherwise attending their disorientation. In copolymers, the infrequency of occurrence of long runs of the crystallizing unit generally precludes multiple participation of the same molecule in a given crystallite. It is suggested that the morphology which developes during crystallization is determined by kinetic factors which preclude achievement of this optimum result. The elementary process in crystallite growth is considered to consist in the deposition of a chain unit rather than of an entire sequence of units. Mobility of chains in the outermost layer of the growing crystal face is viewed as an important factor. (Contractor's abstract, modified)

2810

Stanford U. Dept. of Mechanical Engineering, Calif.

PHASE EQUILIBRIA AND ELECTRICAL PROPERTIES OF A TERNARY INTERMEDIATE PHASE IN THE SILVER-ANTIMONY-TELLURIUM SYSTEM, by R. A. Burmeister and D. A. Stevenson. Dec. 1962, 47p. incl. diagrs. tables, refs (Technical rept. no. 1; rept. no. DMS-62-11) (AF 49(638)1123) AD 297451 Unclassified

A determination of phase equilibria in the region of the Ag-Sb-Te system corresponding to $AgSbTe_2$ has shown that material of this composition will normally exhibit a 2 phase microstructure. The phase which has previously been identified as $AgSbTe_2$ is shown to be an incongruently melting intermediate phase formed by a peritectic type reaction. The region of stability of this phase near the melting point extends from approximately 58 to 60 mol-% Sb_2Te_3 on the Ag_2Te - Sb_2Te_3 section. Hall coefficient and electrical resistivity measurements indicate the single phase material is degenerate with predominantly hole conduction. (Contractor's abstract, modified)

2811

Stanford U. Dept. of Medical Microbiology, Calif.

NEURAMINIC ACID AND CENTRAL NERVOUS SYSTEM FUNCTION (NEURAMINIC ACID IN THE BRAIN AND TISSUES OF VARIOUS ANIMALS), by N. Eldredge, W. Cutting, and G. Read. [Final rept.] [1962] [20]p. incl. diagrs. tables, refs. (AFOSR-2897) (AF 49(638)-714) AD 294997 Unclassified

A comparative study of the sialic acid concentration of the brains and tissues of various animals was made in order to determine whether differences were present which could be correlated with the phylogenetic level of the nervous system. Sialic acid, probably in the form of N-acetylneuraminic acid (NANA) was present in chordate brains in both the ganglioside, G, and lipid-free residue, R. For G the range was 300-600 mg% of the total lipids and for R, 350-600 mg% of the total lipid-free residue. There were no differences which could be correlated with the phylogenetic level of the nervous system. In animals with diffuse nervous systems whole tissues were analyzed and compared to whole mouse tissue. In whole mouse, sea urchins, and clams the R and G fractions were similar and contained both NANA and N-glycoylneuraminic acid, NGNA. In snails the R fraction contained NANA, NGNA and an unidentified spot with the color characteristics of shikimic and quinic acids. The G fraction contained no NANA. Chitons and sea anenomes were similar; the G fraction contained both NANA and NGNA while NANA was missing in the R fraction. All the whole tissues except the sea urchin contained unidentified spots in addition to the NANA and NGNA. (Contractor's abstract)

2812

Stanford U. Dept. of Physics, Calif.

USE OF TRAVELING WAVE HELICES IN ESR AND DOUBLE RESONANCE SPECTROMETERS, by R. H. Webb. [1962] [6]p. incl. diagrs. [AF 18(603)131] Unclassified

Also published in Rev. Scient. Instr., v. 33: 732-737, July 1962.

Use of a traveling wave helix for concentrating microwave fields is discussed, with special attention given to application to electron spin resonance and Overhauser effects (double magnetic resonance). Some practical design considerations are treated. The influence of the standing wave pattern in the helix is treated in the Appendix.

2813

Stanford U. Dept. of Physics, Calif.

EVIDENCE FOR EXCHANGE-COUPLED LINEAR CHAINS IN $Cu(NH_3)_4SO_4 \cdot H_2O$, by R. B. Griffiths. [1962] [8]p. incl. diagrs. refs. (AFOSR-2775) (AF 18-(603)131) AD 283774 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 440, Aug. 27, 1962.

Published values of specific heat and magnetic susceptibility for $Cu(NH_3)_4SO_4 \cdot H_2O$ show broad maxima at a temperature (~3°K) roughly 10 times the Néel temperature. It is shown that the behavior of these quantities above the Néel temperature may be explained qualitatively, and also quantitatively at temperatures near the maxima, in terms of an isotropic antiferromagnetic exchange interaction between neighboring spins in linear chains of copper ions. The exchange energy $|J|/k$ is estimated to be 3.15 ± 0.2°K.

2814

Stanford U. Dept. of Physics, Calif.

[PARAMAGNETIC RESONANCE MAGNETISM THERMAL PROPERTIES AT LOW TEMPERATURE] by G. E. Pake. Final rept. [1962] 4p. (AFOSR-3053) (AF 18-(603)131) Unclassified

This report is a study in paramagnetic resonance. There are 4 major areas of research; the theory of optimum resolution of hyperfine structure in liquids, paramagnetic relaxation times as influenced by exchange interactions, paramagnetic relaxation in solutions of VO^{++}, and knight shifts in stable free radicals.

2815

Stanford U. Dept. of Physics, Calif.

[PARAMAGNETIC RESONANCE MAGNETISM THERMAL PROPERTIES AT LOW TEMPERATURE] by G. E. Pake. Final rept. [1962] 4p. (AFOSR-4038) (AF 18-(603)131) Unclassified

For abstract see item no. 2814, Vol. VI.

2816

Stanford U. [Dept. of Physics] Calif.

THEORY OF EXCHANGE RELAXATION OF HYPERFINE STRUCTURE IN ELECTRON SPIN RESONANCE, by J. D. Currin. Jan. 1962 [31]p. incl. diagrs. refs. (Technical note no. 53) (AFOSR-2204) (AF 49(638)388) AD 276243 Unclassified

Also published in Phys. Rev., v. 126: 1995-2001, June 15, 1962.

The electron spin exchange interaction between colliding molecules is examined as a possible relaxation mechanism for the hyperfine structure of free-radical molecules in solution. An expression is derived which, under suitable conditions, relates the frequency dependent susceptibility to a single parameter q, which can be interpreted as the frequency of spin exchanges. For large values of q the absorption narrows to a single line of width σ^2/q, where σ is the mean square width of the unperturbed spectrum. For small values of q the widths of the individual hyperfine lines are found to depend upon their relative intensities. These results are compared with some recent experiments. (Contractor's abstract)

2817

Stanford U. Dept. of Physics, Calif.

TRIDENT PRODUCTION CROSS SECTION AND

QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES, by M.-C. Chen. [1962] [3]p. incl. diagrs. tables. (Technical note no. 55) (AFOSR-2434) (AF 49-(638)388) Unclassified

Also published in Phys. Rev., v. 127: 1844-1846, Sept. 1, 1962.

The cross section has been calculated for the coincidence experiment of electron-positron pair production from electron-proton collisions as a test of quantum electrodynamics at small distances. The electrons and positrons are considered highly relativistic and the protons are considered as Coulomb field sources; otherwise the calculations are exact to the fourth order of the matrix element. Distances probed are about 0.5°F. (Contractor's abstract)

2818

Stanford U. Dept. of Physics, Calif.

THE 27-FOLD WAY AND OTHER WAYS: SYMMETRIES OF MESON-BARYON RESONANCES, by S. L. Glashow and J. J. Sakurai. Mar. 1962, 33p. incl. refs. (Technical note no. 57) (AFOSR-2435) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)388 and Atomic Energy Commission) AD 274991 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 337-354, July 16, 1962.

Meson-baryon resonances are discussed within the framework of unitary symmetry based upon the Gell-Mann-Ne'eman bary n octet the (eightfold way). It is argued that the low-lying $J=3/2^+$ isobars ($N^*_{3/2}$, Y^*_0, Y^*_1, Y^*_2, etc.) realize a 27-dimensional representation of SU(3). Purely group-theoretic considerations directly following from unitary symmetry are compared with dynamical considerations suggested by the coupling constant combinations required by unitary symmetry and R-symmetry. Higher resonances are briefly discussed. (Contractor's abstract)

2819

Stanford U. Dept. of Physics, Calif.

THE $K^+ \rightarrow \pi^+ + e^+ + e^-$ DECAY, by M. Baker and S. L. Glashow. June 1962, 12p. incl. diagr. (Technical note no. 58) (AFOSR-2563) (AF 49(638)388) AD 277636 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 857-863, Aug. 16, 1962.

The decay mode of the charged K meson into a charged pion and an electron-positron pair is calculated. It has previously been estimated to occur once in ten million events. An occurrence of one in one hundred thousand events is estimated here. The calculation is only an estimate, for the branching ratio depends upon the (experimentally unknown) pion and kaon form factors, and upon the relative role played by vector and axial-vector weak interaction. (Contractor's abstract)

2820

Stanford U. Dept. of Physics, Calif.

BOSON-LIKE BEHAVIOR OF PAIRS OF FERMIONS I, by A. Katz. June 1962, 37p. incl. diagrs. (Technical note no. 56) (AFOSR-2564) (AF 49(638)388) AD 277638 Unclassified

Also published in Nuclear Phys., v. 42: 394-414, Apr. 1963.

A class of diagrams corresponding to the binary collision approximation is chosen out of the perturbation expansion of the thermodynamic potential in diagrams drawn on a cylinder. A subclass of these diagrams corresponding to the formation of non-overlapping pairs yielded the expected result that these pairs behave as free bosons. Exchange effects between pairs are then included as insertions in the former diagrams. This yields an approximation valid up to much higher densities. The pairs now behave as interacting bosons. They still condense at low temperature. The assembly of condensed pairs at zero temperature can maintain a chemical equilibrium with a Fermi sea of unpaired particles. In this way a system of arbitrary density can be approximated which exhibits a smeared Fermi surface and superfluid characteristics. In the translationally invariant case a "simple pairing" of the Bardeen-Cooper-Schrieffer type prevails. However this is a result rather than an assumption. All results are gauge invariant. (Contractor's abstract)

2821

Stanford U. Dept. of Physics, Calif.

THE SYMMETRIZED MANY-CHANNEL ND^{-1} METHOD AND THE POLE APPROXIMATION, by A. W. Martin. June 1962, 7p. (Technical note no. 59) (AFOSR-2566) (AF 49(638)388) AD 277637 Unclassified

The many-channel ND^{-1} technique in dispersion relations proposed by Bjorken (see item no. 2543, Vol. IV) has been reformulated in a way which automatically insures the symmetry of the scattering matrix. The usefulness of this new representation is discussed and it is shown that the representation allows the solution to the many pole approximation problem to be written down by inspection. Possible applications of this solution to physical problems are indicated. (Contractor's abstract)

2822

Stanford U. Dept. of Physics, Calif.

UNITARITY AND HIGH ENERGY INELASTIC SCATTERING, by M. Baker and R. Blankenbecler. June 1962, 23p. incl. diagrs. table. (Technical note no. 60) (AFOSR-2640) (AF 49(638)388) AD 277639 Unclassified

Also published in Phys. Rev., v. 128: 415-420, Oct. 1, 1962.

The effect of approximately enforcing the unitarity requirement on peripheral collision-type approximations is discussed. A matrix formulation of the Fourier-Bessel representation of the scattering amplitude is utilized which automatically satisfies unitarity at high energies. Results indicate that quantitative agreement of the peripheral collision approximation with experiment can be accidental since the corrections due to unitarity take the same form and magnitude as the phenomenological form factors depending only on the momentum transfer which are introduced to account for off-mass-shell effects. Three models are discussed, and one of them has the behavior characteristics of a Regge trajectory. (Contractor's abstract)

2823

Stanford U. Dept. of Physics, Calif.

GENERAL RELATIVITY: THEORY AND EXPERIMENT, by L. I. Schiff. June 1962 [12]p. (Technical note no. 67) (AFOSR-2940) (AF 49(638)388) AD 278437 Unclassified

Presented at meeting of the Soc. Indus. and Appl. Math., Pasadena, Calif., Mar. 23, 1962.

Also published in Jour. Soc. Indus. and Appl. Math., v. 10: 795-801, Dec. 1962.

A review is given of the way in which each of the 3 so-called "crucial tests" of general relativity theory (red shift, deflection of light, planetary orbit precession) relate to parameters of the theory. A fourth, recently proposed, experiment is also discussed from the same point of view. This consists of the measurement of the precession rate of the spin axis of a spherical gyroscope that moves through the earth's gravitational field. (Contractor's abstract)

2824

Stanford U. [Dept. of Physics] Calif.

QUANTIZATION OF A SELF-COUPLED BOSON FIELD, by L. I. Schiff. June 1962 [7]p. (Technical note no. 65) (AFOSR-2941) (AF 49(638)388) AD 278436 Unclassified

Also published in Proc. 1962 Internat'l. Conf. on High-Energy Physics at CERN, Geneva (Switzerland) (July 4-11, 1962), Geneva, Cern, Scientific Information Service, 1962, p. 690-692.

A new method is proposed for the quantization self-coupled boson fields. The field is analyzed in terms of Hermitian amplitudes of an expansion in plane waves, and the wave function of the system is expressed in terms of these amplitudes. The field Hamiltonian then becomes a differential operator. The variational method is applied, using a trial function that consists of products of arbitrary functions of the mode amplitudes that refer to equal and opposite momenta. Explicit expressions for the vacuum, 1-particle, and 2-particle states are obtained, and the rest mass and coupling constant are renormalized. There is only S wave scattering in this approximation, and there can be an S wave bound state of 2 particles if the renormalized coupling constant is sufficiently large and negative. (Contractor's abstract)

2825

Stanford U. [Dept. of Physics] Calif.

FORMAL SIMILARITIES OF WEAK, STRONG AND ELECTROMAGNETIC INTERACTIONS, by M. Baker and S. L. Glashow. June 1962, 20p. (Technical note no. 64) (AFOSR-2942) (AF 49(638)388) AD 278435 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 803-812, Nov. 16, 1962. (AFOSR-J393; AD 408487)

It is shown that symmetries of strong interactions, weak interactions and electrodynamic interactions can be isomorphic, although conflicting. The simplest group of elementary particle transformations admitting this possibility is SU(3). It is also shown that the weak interactions may be invariant under a weak-parity operation, an admissible representation of space reflection which is not a symmetry of the strong interactions. (Contractor's abstract)

2826

Stanford U. Dept. of Physics, Calif.

SPONTANEOUS BREAKDOWN OF ELEMENTARY PARTICLE SYMMETRIES, by M. Baker and S. L. Glashow. June 1962 [44]p. incl. diagrs. refs. (Technical note no. 63) (AFOSR-2943) (AF 49(638)388) AD 278434 Unclassified

Also published in Phys. Rev., v. 128: 2462-2471, Dec. 1, 1962.

Non-perturbative solutions of quantum field theory are sought. A model is considered which possesses the higher symmetry SU(3). It is found that without the introduction into the Lagrangian of any symmetry-breaking terms, solutions exist which have only the lower symmetries of isotopic spin and hyperchange. It is also shown that the usual electrodynamic interaction of the muons and the electrons allows the possibility of generating a mass splitting between them. Finally a Lagrangian is considered in which the bare coupling constants are set equal to zero, and self-generated renormalized coupling constants are found. (Contractor's abstract)

2827

Stanford U. Dept. of Physics, Calif.

DIVERGENCE CONDITIONS AND THE GRAVITATIONAL FIELD EQUATIONS, by H. R. Pagels. June 1962, 15p. (Technical note no. 62) (AFOSR-2944) (AF 49(638)388) AD 278433 Unclassified

Also published in Jour. Math. Phys., v. 4: 731-734, June 1963.

It is shown that in addition to the 4 divergence laws $T^{\alpha\beta}|_\beta = 0$, stress tensors satisfying the Einstein field equation must also satisfy the 6 additional divergence conditions $(T^{\gamma\alpha}|_\beta - T^{\gamma\beta}|_\alpha)|_\gamma = 0$. Conversely under quite general assumptions these 10 conditions on $T_{\alpha\beta}$ dictate the metric-matter connection proposed by Einstein. In the spirit of Rainich theory the entire content of the gravitational field equations is expressed in terms of conditions on the stress tensor.

2828

Stanford U. Dept. of Physics, Calif.

ELECTRON SCATTERING AND EFFECTIVE CHARGE, by J. D. Walecka and R. S. Willey. July 1962 [2]p. incl. diagrs. refs. (Technical note no. 68) (AFOSR-3065) (AF 49(638)388) AD 282500 Unclassified

Also published in Nuclear Phys., v. 40: 282-292, Jan. 1963.

The possibility of studying single-particle nuclear transition charge densities with inelastic electron scattering is discussed and it is pointed out that such experiments lead to valuable information about the nature of the effective charge. A few simple calculations of cross sections are carried out for various models of the effective charge and it is shown that the momentum transfer dependence of the cross section distinguishes between them. (Contractor's abstract)

2829

Stanford U. Dept. of Physics, Calif.

EXCITATION OF INDIVIDUAL PARTICLE STATES OF NUCLEI BY INELASTIC ELECTRON SCATTERING, by R. S. Willey. June 1962 [66]p. incl. diagrs. refs. (Technical note no. 66) (AFOSR-3066) (AF 49(638)388) AD 282615 Unclassified

Also published in Nuclear Phys., v. 40: 529-565, Feb. 1963. (AFOSR-J394; AD 407369)

Formulas are given for the computation of cross sections for excitation of shell model states in light nuclei by inelastically scattered electrons. The contributions from the transverse electric and magnetic interactions are calculated in detail. The determination of radiative lifetimes by extrapolation of electron scattering data is discussed and found to be model-dependent. Particular calculations are carried out for Li^7 and O^{18}. The Li^7 calculation provides an example in which the contributions from the transverse interactions are of the same order of magnitude as the contribution from the Coulomb interaction, even at small momentum transfer. In the case of O^{18}, electron scattering experiments may distinguish collective excited states from individual-particle states. (Contractor's abstract)

2830

Stanford U. Dept. of Physics, Calif.

ELECTROMAGNETIC RADIATIVE CORRECTIONS AND THE ELEMENTARY NATURE OF THE PHOTON, by M. Lévy. [1962] [4]p. incl. diagr. [Rept. no. T527; rept. no. ITP-70] (AFOSR-3955) (AF 49(638)388) AD 408941 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 235-238, Sept. 1, 1962.

The connection which was found between radiative effects and Regge poles puts the calculation of electromagnetic radiative corrections in a new perspective. For example, it is the knowledge of the fine structure of the positronium spectrum which leads one to believe that there probably are spin-dependent terms which should be summed in an exponential factor in the electron-proton scattering cross-section. Also, the main part of the radiative corrections in a given process at high energy can probably be estimated directly from the known energy spectrum of the intermediate states allowed in the crossed channel. Finally, the question of the origin of the Regge poles is discussed again. In the theory of strong interactions, where one does not have a consistent field theory to start with, the question of whether Regge poles are "fundamental" or whether they can be derived by calculations based on a specific Lagrangian is rather a matter of taste (or, as has been said, a "philosophical" question). In quantum electrodynamics, the situation is different, because there exists a field theory enabling us to make predictions which can be tested experimentally. (Contractor's abstract)

2831

Stanford U. Dept. of Physics, Calif.

TRIDENT PRODUCTION CROSS SECTION AND QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES, by M.-C. Chen. [1962] [3]p. incl. diagrs. tables. (Technical note no. 55) (AFOSR-3956) (AF 49(638)388) Unclassified

Also published in Phys. Rev., v. 127: 1844-1846, Sept. 1, 1962.

For abstract see item no. 2817, Vol. VI.

2832

Stanford U. Dept. of Physics, Calif.

EVALUATION OF THE VAN HOVE CORRELATION FUNCTIONS FOR CERTAIN PHYSICAL SYSTEMS, by R. B. De Bar. [1962] 23p. incl. refs. (AFOSR-4319) (AF 49(638)388) Unclassified

Also published in Phys. Rev., v. 130: 827-832, Apr. 15, 1963.

The space and time Fourier transforms of the Van Hove correlation function are evaluated for the cases of coherent scattering from simple crystals, and in a

"quantum hydrodynamics" approximation, from liquid He II. A compact approximate expression for the 1-phonon part of the crystal correlation function transform is given, and the contribution of the 2-phonon term is considered. A new method of obtaining quantum-mechanical corrections to the classical expression for the Van Hove self-correlation function is discussed, and the result is shown to be of greater potential accuracy than those previously given in the literature. As a test, the prescription is applied to the Langevin equation result for the classical correlation function, and the product is found to differ significantly from recent results, but to be in agreement with an older expression obtained by Vineyard.

2833

Stanford U. Dept. of Physics, Calif.

GENERAL RELATIVITY: THEORY AND EXPERIMENT, by L. I. Schiff. June 1962 [12]p. incl. refs. (Technical note no. 67) (AFOSR-J229) (AF 49(638)388) AD 400854 Unclassified

Presented at meeting of the Soc. Indus. and Appl. Math., Pasadena, Calif., Mar. 23, 1962.

Also published in Jour. Soc. Indus. and Appl. Math., v. 10: 795-801, Dec. 1962.

For abstract see item no. 2823, Vol. VI.

2834

Stanford U. Dept. of Physics, Calif.

THE RESCATTERING CORRECTION TO THE DEUTERON ELECTRODISINTEGRATION, by B. Bosco and R. B. De Bar. July 1962 [9]p. incl. diagrs. (Technical note no. 61) (AFOSR-J231) (AF 49(638)-388) AD 400853 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 604-612, Nov. 1, 1962.

An evaluation of the S-wave rescattering correction for the deuteron electrodisintegration cross-section is discussed on the basis of a treatment previously proposed by one of the authors. It is shown that this correction is quite important for the determination of the neutron form factors. Experiments permitting the extension of the present treatment to the P-waves are suggested. (Contractor's abstract)

2835

Stanford U. Dept. of Physics, Calif.

HIGH-FREQUENCY REGION OF THE SPECTRUM OF ELECTRON AND POSITRON BREMSSTRAHLUNG, by R. J. Jabbur and R. H. Pratt. [1962] [7]p. incl. diagrs. table, refs. (Technical note no. 69) (AFOSR-J232) (AF 49(638)388) AD 400852 Unclassified

Also published in Phys. Rev., v. 129: 184-190, Jan. 1, 1963.

The cross section for a bremsstrahlung process in which almost all the energy of an incident high-energy electron is transferred to the photon is calculated analytically, using techniques previously developed for atomic photoeffect. Only terms of relative orders a^4, a^2q^2, and q^4 are neglected, where $a = Ze^2$ and q is the momentum of the outgoing low-energy electron (with $\hbar = c = m_e = 1$). Similar results are obtained for positron bremsstrahlung and pair production; previous work on the photoeffect is extended. The accuracy of these predictions is discussed, and they are compared with experiments.

2836

Stanford U. Dept. of Physics, Calif.

FORMAL SIMILARITIES OF WEAK, STRONG AND ELECTROMAGNETIC INTERACTIONS, by M. Baker and S. L. Glashow. [1962] [10]p. (AFOSR-J393) (AF 49(638)388) AD 408487 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 803-812, Nov. 16, 1962.

For abstract see item no. 2825, Vol. VI.

2837

Stanford U. Dept. of Physics, Calif.

EXCITATION OF INDIVIDUAL PARTICLE STATES OF NUCLEI BY INELASTIC ELECTRON SCATTERING, by R. S. Willey. [1962] [37]p. incl. diagrs. refs. (AFOSR-J394) (AF 49(638)388) AD 407369 Unclassified

Also published in Nuclear Phys., v. 40: 529-565, Feb. 1963.

For abstract see item no. 2829, Vol. VI.

2838

Stanford U. Dept. of Physics, Calif.

LEVEL SPECTRA OF A = 6 NUCLEI FROM THE FREE NUCLEON-NUCLEON INTERACTION, by J. F. Dawson and J. D. Walecka. [1962] [32]p. incl. diagrs. refs. (AFOSR-J627) (AF 49(638)388) AD 414098 Unclassified

Also published in Ann. Phys., v. 22: 133-164, Apr. 1963.

The calculational procedure recently discussed by Dawson, Talmi, and Walecka for calculating level spectra of double-magic-plus-two-nucleon nuclei from the free nucleon-nucleon interaction is applied to the A = 6 system. A Bethe-Goldstone equation is written for the 2 external nucleons and by working within an harmonic oscillator framework, the equation can be transformed

to relative coordinates and solved. The free nonsingular nucleon-nucleon interaction (independent of the form used) is found to give a good fit to all the known levels, and the more sophisticated Brueckner-Gammel-Thaler and Hamada potentials are found to give essentially the same results, after careful examination of the effect of the strong tensor coupling in the T = 0 states. This, in a sense, justifies previous calculations of spectra of light nuclei with nonsingular interactions. Somewhat too much absolute binding energy is found, presumably because of the use of harmonic oscillator single-particle potentials. Quite good agreement is found for the magnetic moment of Li^6 and the f_τ value for the ground state β decay $He^3 - Li^6$ (both within <6%) and also for the quadrupole moment of Li^6, using the more complicated potentials. (Contractor's abstract)

2839

Stanford U. Dept. of Physics, Calif.

APPLICATION OF THE VARIATION METHOD TO FIELD QUANTIZATION, by L. I. Schiff. [1962] [7]p. incl. refs. (AFOSR-J634) (AF 49(638)388) AD-14004 Unclassified

Also published in Phys. Rev., v. 130: 458-464, Apr. 1, 1963.

Application of the variation method to simple field theory is presented. A representation is found in which the state functions are emphasized. Variational trial forms are chosen for these, and optimized by making the expectation value of the field Hamiltonian stationary. Only the simplest case of a neutral, spin-zero, boson field with a fourth-power self-coupling term is considered here, but it is hoped that with further elaboration this may in the future lead to a description of the multipion resonances. The variation method has the advantage of avoiding any limitation on the strength of the self-coupling. Explicit results are obtained for the vacuum, single-particle, and 2-particle (scattering and bound) states, and comparison is made with the determinantal method. Finally, a criterion for the variational stability of the vacuum state is obtained.

2840

Stanford U. [Dept. of Physics] Calif.

TWO-MAGNON PROCESSES IN FERROMAGNETIC RELAXATION, by M. Sparks. [1961] [2]p. [AF 49-(638)388] Unclassified

Published in Phys. Rev. Ltrs., v. 8: 54-55, Jan. 15, 1962.

The apparent conflict between the experimental results of Le Craw et al, that the surface roughness of YIG has little effect on the parallel-pumping instability threshold and the theoretical prediction of Sparks et al, that 2-magnon relaxation is dominant in this case is discussed. It is proposed that 2-magnon scattering is usually so strong that degenerate magnons are extremely tightly coupled. The effects of this process on other ferromagnetic relaxation experiments is discussed.

2841

[Stanford U. Dept. of Physics, Calif.]

BOSON-LIKE BEHAVIOR OF PAIRS OF FERMIONS II, by A. Katz. [1962] [12]p. incl. diagrs. [AF 49(638)-388] Unclassified

Published in Nuclear Phys., v. 42: 416-427, Apr. 1963.

The work of a previous paper (see item no. 2820, Vol. VI) is generalized here to arbitrary densities. This is achieved by generalizing the summation over ladders which spiral around the cylinder to arbitrary values of u and by including somewhat less insertion in these ladders than was previously done. The result is a description of a paired system with smeared occupation number distribution. There is no inherent limit on the density. (Contractor's abstract, modified)

2842

Stanford U. [Dept. of Physics] Calif.

CALCULATION OF THE PHOTOEFFECT (Abstract), by R. H. Pratt, R. D. Levee and others. [1962] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 492, Aug. 27, 1962.

A numerical program has been developed for the calculation of atomic photoelectric differential and total cross sections, including all polarization correlations. The program is designed to calculate relativistic electron wavefunctions in a screened Coulomb potential. Forty terms are included in the partial-wave expansion for the wavefunction of the outgoing electron. A detailed analysis is made of the sources of error in the calculation, and it is believed that the results obtained are accurate within 1%. Results have thus far been obtained for K-shell photoeffect, neglecting electron screening, covering the energy range from 200 kev to 2 mev, for elements from Z = 26 to Z = 92. These results may be compared with previous theoretical predictions, based mainly on various analytic approximations and extrapolations from them. Comparisons are also made with recent experimental results for the process.

2843

Stanford U. [Dept. of Physics] Calif.

CALCULATION OF THE TIP OF THE BREMSSTRAHLUNG SPECTRUM (Abstract), by R. J. Jabbur and R. H. Pratt. [1962] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 609, Dec. 27, 1962.

A numerical program has been developed to calculate the total cross section for high-energy electron bremsstrahlung, in the Coulomb field of a nucleus of charge Z, in the tip limit, i.e., when almost all the energy of the incident electron is transferred to the photon. The formalism needed for this purpose was developed in analytical work which calculated the cross section as the first 4 terms of a power series in Z. At high energies, the use of a modified plane wave to describe the incoming electron becomes exact, and the cross section becomes a series of cross sections for the possible angular-momentum states of the outgoing low-energy electron. The purpose of the present numerical calculation is to settle 2 questions that analytical work has not answered: (1) How well is a given partial-wave cross section represented by the first few terms of a series in Z? (2) How many partial waves make a significant contribution to the total cross section?

2844

Stanford U. [Dept. of Physics] Calif.

COULOMB GREEN'S FUNCTIONS AND THE FURRY APPROXIMATION (Abstract), by L. Hostler. [1962] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Stanford U. Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 609, Dec. 27, 1962.

The Coulomb Green's function for the nonrelativistic Schrödinger equation has been obtained in closed form using an integral representation for a product of 2 Whittaker functions with different arguments. The Neumann series for $J_\nu(kz)$ is required in evaluating the sum on states. Similarly, the relativistic Coulomb Green's functions, Klein-Gordon and Dirac, have been obtained in closed form in the "Furry approximation" $(Z^2e^4/\hbar^2c^2)/l^2<<1$. The Klein-Gordon Green's function in this approximation is also the exact Green's function for the Klein-Gordon equation without the potential squared term. An alternate and very simple derivation of the approximate Dirac Green's function is given using perturbation theory (along the lines of Meixner). A parallel treatment of the Coulomb wavefunctions with (modified) plane-wave behavior at infinity can be given in which the only sum formula needed is the Neumann series (above).

2845

Stanford U. [Dept. of Physics] Calif.

EFFECTS OF INTERMEDIATE VECTOR BOSONS IN RADIATIVE DECAYS (Abstract), by E. S. Ginsberg and R. H. Pratt. [1962] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 502, Aug. 27, 1962.

The effects of an intermediate vector boson in the radiative decay modes $\pi(K) \to \mu(e) + \nu + \gamma$ and $\mu \to e + \nu + \bar{\nu} + \gamma$ are systematically investigated. Possible anomalous magnetic-moment and quadrupole-moment terms are included. This work extends the results of Berman, Ghani, and Salmeron on $K \to e + \nu + \gamma$, and the results of Eckstein and Pratt on $\mu \to e + \nu + \bar{\nu} + \gamma$. The cross section for the emission of a photon at a large angle with respect to the muon in $K \to \mu + \nu + \gamma$ can be nearly doubled if an intermediate boson, with mass $M_b \sim m_K$, exists. Radiative corrections to the $\mu(e)$ polarization from $\pi(K)$ decay have also been calculated. The lepton polarization is no longer complete, due to the possible emission of soft photons, but the correction is small.

2846

Stanford U. [Dept. of Physics] Calif.

LATTICE-SPACE QUANTIZATION OF A NONLINEAR FIELD THEORY (Abstract), by L. I. Schiff. [1962] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 299, Apr. 23, 1962.

In an earlier paper (see item no. STA. 03: 002, Vol. I.) the gradient (kinetic energy) term in the field Hamiltonian was treated as a perturbation on a solution which takes the nonlinearity into account exactly. In the present paper, gradient and nonlinear terms are treated on an equal basis by means of a variational method in which oscillator trial functions are used. The ground state (vacuum) energy is obtained explicitly, and goes over continuously into that for the neutral scalar-spin zero field when the coefficient of the nonlinear term vanishes. For very small lattice constant l, the vacuum energy per unit volume is proportional to l^{-4} in both the linear and nonlinear cases. The energies of the first-excited (single particle) states are being calculated.

2847

Stanford U. Dept. of Physics, Calif.

SPECULATIONS CONCERNING THE $\Delta S = \Delta Q$ REACTIONS AND THE INTERMEDIATE BOSON STRUCTURES

IN WEAK INTERACTIONS, by T. D. Lee. [1962] [3]p. (AFOSR-J704) (AF AFOSR-62-452) AD 413640
Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 319-321, Oct. 1, 1962.

The purpose of this note is to show that a single set of 6 bosons (consisting of 2 positive, 2 neutral, and 2 negative particles) is sufficient to produce the following patterns of the usual weak interactions: (1) Existence of $\Delta S = -\Delta Q$ reactions in the decay of strange particles; (2) Absence of $|\Delta S| > 1$ reactions; (3) Validity of $|\Delta \vec{I}| = 1/2$ rule for all nonleptonic decays of strange particles; and (4) Absence of neutral lepton currents. Results indicate that $W_1^{\pm}$ (where W = intermediate bosons) decays predominantly into leptons and pions. The $W_2^{\pm}$ has a much longer lifetime, and it decays predominantly into K particles.

2848

Stanford U. Div. of Engineering Mechanics, Calif.

COMPUTATION OF THE COMPRESSIBLE LAMINAR BOUNDARY-LAYER FLOW INCLUDING DISPLACEMENT-THICKNESS INTERACTION USING FINITE-DIFFERENCE METHODS, by I. Flügge-Lotz and F. G. Blottner. Jan. 1962 [135]p. incl. diagrs. refs. (Technical rept. no. 131) (AFOSR-2206) (AF 49(638)550) AD 273983 Unclassified

The equations for the laminar compressible boundary layer are presented along with the necessary boundary conditions. The equations are nondimensionalized, which results in using quantities of the same order of magnitude better suited for computations. The boundary-layer equations are also modified using the Howarth-Dorodnitsyn transformation, which results in equations advantageous for numerical computation when the flow is hypersonic. Since the boundary conditions require that the enthalpy and velocity be known at the outer edge of the boundary layer, the necessary formulas are presented to calculate the exterior flow, provided the pressure distribution is known. Finally, the characteristic values of the boundary layer (shearing stress, heat transfer, and displacement thickness) are defined. (Contractor's abstract)

2849

Stanford U. High-Energy Physics Lab., Calif.

NUCLEAR EXCITATION BY 180° ELECTRON SCATTERING, by R. D. Edge and G. A. Peterson. July 23, 1962, 6p. incl. diagrs. tables, refs. (AFOSR-J331) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) AD 408008
Unclassified

Also published in Phys. Rev., v. 128: 2750-2755, Dec. 15, 1962.

Magnetic multipole transitions in Be^9, B^{10}, C^{12}, N^{14}, O^{16}, and Si^{28} were studied by measuring the energy spectra resulting from the scattering of 41.5-mev primary electrons through an angle of 180°. At this angle of scattering, electric multipole transitions were greatly suppressed, and in addition, the background radiation tail accompanying the elastic peak was minimized. Inelastic electron scattering cross sections were obtained by comparing the inelastic peaks to the electron-photon elastic scattering peak and radiation widths were deduced by using virtual photon theory. Inelastic scattering peaks corresponding to excitation energies of 2.4 and 14.7 mev were measured for Be^9; 7.9, 11.8 and 14.0 mev for B^{10}; 2.1, 4.4, 4.9, 7.3, 9.1, 10.4, and 12.9 mev for B^{11}; 15.1 mev for C^{12}; 9.2 and 10.5 mev for N^{14}; and 11.6 mev for Si^{28}. No excitations were observed for O^{16} below 15 mev, and no excitations were observed in Ca^{40} below the giant resonance for 160° electron scattering. (Contractor's abstract)

2850

Stanford U. High-Energy Physics Lab., Calif.

SCATTERING OF HIGH-ENERGY POSITRONS FROM PROTONS, by D. Yount and J. Pine. [1962] 33p. incl. diagrs. table, refs. (Rept. no. HEPL-263) (AFOSR-J480) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commision, and Office of Naval Research under [N6onr-25116])
Unclassified

Also published in Phys. Rev., v. 128: 1842-1849, Nov. 15, 1962.

Positron and electron beams from the Stanford Mark III linear accelerator have been used to investigate the importance of 2-photon exchanges in electron scattering from the proton. The scattering cross sections for positrons and electrons have been compared at 200 and 300 mev for q^2 (the square of the 4-momentum transfer) from 0.3 to 5.2 F^{-2}. The results show no evidence of anomalous 2-photon effects and verify the correctness of the first Born approximation form factor analysis to within a few percent or better for this range of q^2. The variation of the cross sections with q^2 has also been measured with high accuracy. The specific ionizations of 300-mev positrons and electrons in hydrogen at one atmosphere have been compared in the course of the experiment, and found to be equal to within ± 0.3%. (Contractor's abstract)

2851

Stanford U. High-Energy Physics Lab., Calif.

PHOTOPROTONS FROM OXYGEN, FLUORINE, NEON, AND OTHER LIGHT ELEMENTS, by W. R. Dodge and W. C. Barber. [1962] [26]p. incl. diagrs. tables, refs. (AFOSR-J500) (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. 127: 1746-1771, Sept. 1, 1962.

The (γ,p) reaction in O, F, Ne, and C has been studied with electrons of energies up to 36 mev. Survey studies were made of the Al, Ar, and B (γ,p) energy spectra. It has been theoretically predicted and received partial experimental verification that there is a 1 to 1 correspondence between electron- and photon-induced reactions, and that one can assume, when analyzing electron-production yields, that the electron has associated with it a virtual-photon spectrum, similar to the real-photon bremsstrahlung spectrum. The electron production yields were analyzed with the use of the E1 virtual-photon spectrum to obtain σ(γ,p). The proton yields and corresponding cross section of C, F, and Ne contain more than 2 peaks or resonances. Ne has a series of well-resolved, evenly spaced peaks whose envelope has the usual giant-resonance shape. The peaks occur at laboratory proton energies of 3.20, 3.70, 4.58, 5.80, 6.65, 7.75, 8.65, 9.40, and 11.40 mev. The final-state properties of the Ne protons from 4 to 10 mev and the O protons from 9.2 to 12.4 mev were determined to within 20% by excitation experiments. Angular distribution measurements over a considerable region of the giant resonances are presented for O, F, Ne, and C. (Contractor's abstract)

2852

Stanford U. [High-Energy Physics Lab.] Calif.

INELASTIC ELECTRON SCATTERING FROM V^{51}, by H. W. Kendall and I. Talmi. July 16, 1962 [31]p. incl. diagrs. tables. (Rept. no. HEPL-261) (AFOSR-J501) (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. 128: 792-800, Oct. 15, 1962.

Shell-model predictions of the relative inelastic electron scattering cross section for excitation of the first 4 excited states of V^{51} are made using effective single-particle operators and the known configurations of these states. The predicted crosssections for excitation of 3 of these levels are compared with measured scattering cross sections determined at scattering angles less than 60° using electrons of primary energy 183, 300, and 600 mev. (Contractor's abstract)

2853

Stanford U. High-Energy Physics Lab., Calif.

DEUTERON MAGNETIC DIPOLE DISINTEGRATION BY 180° ELECTRON SCATTERING, by G. A. Peterson and W. C. Barber. [1962] [9]p. (Rept. no. HEPL-260) (AFOSR-J502) (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. 128: 812-820, Oct. 15, 1962.

The magnetic dipole disintegration of the deuteron has been measured for excitation energies up to 16 mev in the presence of relatively small electric multipole contributions by using a method of inelastic electron scattering at 180°. Electrons of initial energy 41.5 mev were magnetically deflected before and after scattering so that those scattered at 180° entered a magnetic spectrometer set at 160° with respect to the incident beam. The experimental cross sections measured relative to elastic scattering from the proton are higher than predicted by the electrodisintegration theory of Jankus. The discrepancy may be an indication of mesonic exchange currents which are not included in the Jankus theory. (Contractor's abstract)

2854

Stanford U. [High-Energy Physics Lab.] Calif.

NEUTRON FORM FACTORS AND NUCLEON MODELS, by C. de Vries, R. Hofstadter, and R. Herman. [1962] [5]p. incl. diagrs. refs. (AFOSR-64-0047) (In cooperation with General Motors Corp.) (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. 24-27, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 45, Jan. 24, 1962.

Also published in Phys. Rev. Ltrs., v. 8: 381-385, May 1, 1962. (Title varies)

Recent data has been obtained on the neutron form factors from new investigations of the electrodisintegration of the deuteron. An analysis based on the Durand-Goldberg approximation to the peak cross section gives F_{1n} values smaller than those found previously using the modified-Jankus theory but in agreement with these results within the earlier experimental errors. F_{2n} values are in close agreement with those found previously. New values of the parameters in recently proposed models of the nucleons will be given. The effect of deuteron final-state interactions on the determinations of the form factors will be discussed.

2855

Stanford U. [High-Energy Physics Lab.] Calif.

ANGULAR DISTRIBUTIONS AND BOUND-NUCLEON FORM FACTORS BY ELECTRON-PROTON COINCIDENCE DETECTION IN INELASTIC ELECTRON-DEUTERON SCATTERING (Abstract), by D. Aitken and R. Hofstadter. [1962] [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 U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 489, Aug. 27, 1962.

An experiment is now under way at Stanford to study the angular distribution of outgoing protons from inelastic electron-deuteron scattering by means of electron-proton coincidence detection. It is felt that a systematic investigation of this sort will detect any change in the free-particle form factors resulting from nucleon-nucleon binding, including exchange effects, and will, in addition, provide limits on the magnitude of final-state interaction effects. Counter absolute efficiencies and coincidence radiative corrections are determined by normalizing e⁻-p coincidence cross sections from H_2 with the proton values. The over-all correction is ~16%. Considerable machine time has been spent on one point--incident electron energy of 500 mev, and electron scattering angle of 75°. The coincidence cross section $d^3\sigma/d\Omega_e d\Omega_p dE'_e$ has been determined with a probable error of less than 10%, and compared with a calculation by Durand using a Hulthen wavefunction for the deuteron and assuming free-proton form factors. Experiment shows a value ~20% smaller than predicted. Relativistic corrections, D-state contributions, and cross sections with other potential models are being calculated for comparison.

2856

Stanford U. [High-Energy Physics Lab.] Calif.

DETECTION OF π MESONS IN THE PRESENCE OF ELECTRONS USING A NaI(Tl) DETECTOR (Abstract), by S. Berezin, R. Hofstadter, and M. R. Yearian. [1962] [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., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 620, Dec. 27, 1962.

Pions have been observed in the momentum range 300-500 mev/c that are produced in a liquid-deuterium target by the electron beam of the Stanford Mark III linear accelerator. The detector is used at the exit of the 72-in. magnetic spectrometer and employs a 3 x 3-in. NaI(Tl) crystal gated by a plastic scintillator. The pulse heights due to the ionizing π^- mesons and the electromagnetic shower of the accompanying electrons are displayed on a multichannel pulse-height analyzer. The pions give a sharp peak superimposed on the broad, electron shower spectrum. As the momentum is increased, the position of the pion peak is virtually unchanged while the shower spectrum shifts to higher pulse heights so that greater separation is achieved at the higher momenta. The π^- detection is checked by observing π^+ mesons without a background of electrons. The pure-electron spectrum can be determined by eliminating pions from the analyzing magnet by choice of kinematics. The method promises to be very useful for finding the π^-/π^+ ratio in deuterium for electroproduced pions and for many other processes.

2857

Stanford U. [High-Energy Physics Lab.] Calif.

ELECTRIC AND MAGNETIC FORM FACTORS OF THE He^3 NUCLEUS (Abstract), by H. Collard and R. Hofstadter. [1962] [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 U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 489, Aug. 27, 1962.

Differential cross sections for elastic scattering of electrons from gaseous He^3 have been measured for incident electron energies between 100 and 700 mev at electron angles from 40° to 135°. Absolute cross sections were obtained by normalization with proton cross sections at every measured point. The He^3 cross sections were equated to a Rosenbluth-type formula, using the charge and measured magnetic moment of the He^3 nucleus. In this way, the He^3 form factors $F_1(q^2)$ and $F_2(q^2)$ were determined in the range $q^2 = 1 - 5\ F^{-2}$. The values of F_1 were fitted approximately by means of a Gaussian charge-density distribution with rms radius 1.86 ± 0.19 F. F_2 can be fitted approximately with a magnetic-moment density distribution corresponding to a Gaussian of rms radius 1.68 ± 0.17 F. Corresponding results are also found with other models, such as the hollow exponential, with radii of 2.07 and 1.90 F for the electric and magnetic distribution, respectively. Thus, in He^3, the magnetic distribution is smaller in geometric size than the charge distribution.

2858

Stanford U. [High-Energy Physics Lab.] Calif.

ELECTRON-DEUTERON SCATTERING AT HIGH-MOMENTUM TRANSFER (Abstract), by E. F. Erickson and H. W. Kendall. [1962] [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., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 620, Dec. 27, 1962.

Elastic electron-deuteron scattering cross sections have been measured for 4-momentum transfer q in the range 2.4-4.1 F^{-1} by detecting the recoil deuterons. Results are presented and compared with previous experimental work at lower values of q, and with the predictions of the Jankus theory using various deuteron models and the experimental values of the nucleon form factors. The "quadrupole" distribution is observed to dominate the scattering at the higher-momentum transfers.

2859

Stanford U. High-Energy Physics Lab., Calif.

ELECTRON-PROTON COINCIDENCES IN INELASTIC ELECTRON-DEUTERON SCATTERING, by M. Croissiaux. June 1962 [52]p. incl. diagrs. refs. (Rept. no. HEPL-264) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) AD 414692 Unclassified

Also published in Phys. Rev., v. 127: 613-616, July 15, 1962.

Electron-proton coincidences in inelastic electron-deuteron scattering were detected under the following conditions: incident beam energy 500 mev; electron scattered at 75° and 359 mev; proton detected at 40°23' (the q direction for the e-p elastic scattering). The coincidence cross-section with a D_2 target was found to be $(4.2 \pm 0.8) \times 10^{-32}$ cm^2/sr^2 mev. The experimental result agreed, within the statistical errors, with the value calculated from a theory of Durand. One may conclude that proton form factors in a bound state and the free state do not differ significantly.

2860

Stanford U. [High-Energy Physics Lab.] Calif.

HIGH-ENERGY ELECTRON-PROTON SCATTERING AT 180° (Abstract), by P. A. M. Gram and E. B. Dally. [1962] [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 U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 489, Aug. 27, 1962.

Absolute cross sections for elastic electron-proton scattering at 180° have been measured in the momentum transfer squared (q^2), range 5.64 to 20.2 F^{-2} by detecting recoil protons at 0° with a magnetic spectrometer and counter telescope. At each of 5 fixed values of q^2, cross sections were also measured for protons recoiling at 10° and 15°, with the incident electron energy programmed to maintain q^2 constant. The Rosenbluth corss-section formula which describes the process can, at constant q^2, be represented by a straight line: $d\sigma\ d\Omega$ vs $\cot^2\theta/2$ where θ is the scattered electron angle. Combining sets of 3 cross sections at constant q^2, a least-squares fit of a line to the data data was made. The intercept, which is the point at 180°, determines $(F_1 + kF_2)^2$, the purely magnetic contribution to the scattering process. Knowledge of both slope and intercept enables one to solve for F_1 F_2 separately and to determine the statistical error to be associated with them. Details of the experiment and analysis are presented along with the results, which are in general agreement with those described by Bumiller, Croissiaux, Dally, and Hofstadter. (see item no. 2762, Vol. V)

2861

Stanford U. [High-Energy Physics Lab.] Calif.

HIGH-ENERGY ELECTRON SCATTERING FROM C^{12} AND O^{16} (Abstract), by H. Crannell. [1962] [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., Stanford U., Calif. Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 620, Dec. 27, 1962.

An experiment is in progress to measure the differential cross section for elastic and inelastic scattering of electrons from C^{12} and O^{16} with incident electron energies of 600 and 800 mev. Momentum transfers of greater than 3.2 F^{-1} have been studied. Absolute elastic-scattering cross sections are obtained by normalization with proton cross sections. The use of a 10-channel counter system, with a resolution of 0.37%, allows the 4.4- and 9.6-mev levels in C^{12} and the 6.6-mev levels in O^{16} to be resolved. Cross sections for these levels are measured, subject to the usual errors involved in radiative unfolding. A phase-shift analysis of the data is planned.

2862

Stanford U. High-Energy Physics Lab., Calif.

INELASTIC ELECTRON SCATTERING, by W. C. Barber. 1962, 42p. 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 Ann. Rev. Nucl. Sci., v. 12: 1-42, 1962.

This review is concerned with the exploration of nuclear energy states by means of inelastic electron scattering. This entire review is limited to cases where scattering of electrons (negative or positive) produces the nuclear excitation. The subject is limited still further by excluding those inelastic processes where mesons are produced. The excitation energies at 100 mev or less are considered. The theory of inelastic electron scattering is discussed in chapter II. Included are the cross sections for scattering with nuclear excitation as calculated by different approximate theories. In part B, the competing background-producing process of bremsstrahlung during elastic scattering is considered. The close relationship between the inelastic electron scattering cross section and the photon absorption cross section is discussed in part C. In chapter II A, the apparatus used in inelastic electron scattering is described. Part B discusses very briefly the apparatus for electrodisintegration

experiments, and part C considers the possibility of coincidence experiments in which the scattered electron and a nuclear particle are detected simultaneously. Chapter IV describes the experimental results and how they are combined with the theories to derive properties of nuclear excited states.

2863

Stanford U. [High-Energy Physics Lab.] Calif.

INELASTIC ELECTRON SCATTERING FROM DEUTERIUM (Abstract), by M. R. Yearian, R. Hofstadter, and E. B. Hughes. [1962] [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 U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 489, Aug. 27, 1962.

A new series of high-accuracy investigations has been started to determine the form factors of the neutron by the inelastic scattering of high-energy electrons from deuterium. Several new techniques are used to improve the accuracy of the data. Thin liquid-hydrogen and deuterium targets are used in place of more-conventional long targets. The thin targets reduce the radiation corrections and also the backgrounds from photoinduced reactions, such as pion production. We are also using a 10-channel ladder of scintillation counters backed up by a large Cerenkov counter as our detector. This detector permits collecting data at 10 different scattered electron energies simultaneously, thus improving the resolution as well as reducing the time necessary to collect data. Finally, we collect a very large amount of data at each energy and angle, taking hydrogen and deuterium points with high accuracy. The over-all accuracy of the points is better than 3%. Preliminary data are presented for q^2 values of 5.0 and 10.0 F^{-2}. The analysis is made using both the peak method and the area method. Values of the neutron form factors are presented.

2864

Stanford U. [High-Energy Physics Lab.] Calif.

LOW-MASS ANOMALY IN PHOTOPRODUCTION OF PION PAIRS, by B. Richter. [1962] [4]p. incl. diagrs. table, 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. Ltrs., v. 9: 217-220, Sept. 1, 1962.

An anomaly in the production of pion pairs in the reaction $p + d \rightarrow He^3 + 2\pi$ has been previously observed. It occurs in the isotopic spin state T = 0 of the 2 pions and is interpreted as being caused by a final-state interaction of the 2 pions. The experiment described in this paper was an attempt to observe the anomaly in the reaction $\gamma + p \rightarrow p +$ ABC, where ABC refers to the anomaly, without any restriction on possible decay modes of the ABC if it is a particle. Brief details of the apparatus used and the corrections applied to measured quantities are provided. Kinematics were arranged so that the ABC was produced at c. m. angle of about 90°. The properties of the ABC as measured by the experiment are mass = 322 ± 8 mev, width ≤ 20 mev (full width at half maximum) and $(d\sigma/d\Omega)_{c.m\,90^\circ} = (0.75 \pm 0.20) \times 10^{-30}$ cm^2/sr.

2865

Stanford U. High-Energy Physics Lab., Calif.

MAGNETIC FORM-FACTORS BY 180° ELECTRON SCATTERING, by G. A. Peterson. [1962] [2]p. incl. diagr. (HEPL-277) (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. 2: 162-163, Sept. 1, 1962.

Measurements of magnetic scattering of 180° are possible without finding the usual angular distribution of scattering electrons but in order to accomplish such measurements special techniques are described and the results are provided for elastic scattering from equivalent Li^6 and Li^7 targets. It is pointed out that data taken over a larger range of momentum transfers than available in the experiment described could provide additional information about ground state wave functions that can be obtained by conventional electron scattering experiments.

2866

Stanford U. [High-Energy Physics Lab.] Calif.

NEW ABSOLUTE CROSS SECTIONS FOR ELECTRON SCATTERING BY THE PROTON (Abstract), by T. [J.] Janssens, R. Hofstadter and others. [1962] [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 U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 488, Aug. 27, 1962.

Absolute electron cross sections were measured using a flat, thin-walled hydrogen target. Lucite and liquid Cerenkov counters were employed to check detector efficiency and cross sections with the 2 detectors agreed to 2%. The cross sections at $q^2 = 10$ F^{-2} were analyzed by the slope-intercept method to give preliminary values for the Dirac and Pauli form factors of $F_1 = 0.478 \pm 0.020$ and $F_2 = 0.353 \pm 0.015$. Both the measured cross sections and the form factors are in excellent agreement

with values previously obtained using polyethylene targets and a carbon-subtraction method. The thin stainless-steel target windows have the advantage of small background and the disadvantage of bulging under pressure. Radiative corrections evaluated by the Tsai method were applied. With background only a few percent of the peak, we were able to make measurements farther out on the tail and so required smaller corrections than previously. The target thickness was measured optically through a hole in the heat shield and, at the temperature and pressure used, showed an 18% increase. Further analysis and elimination of error is in progress.

2867

Stanford U. [High-Energy Physics Lab.] Calif.

NEW DETERMINATIONS OF PROTON FORM FACTORS (Abstract), by T. J. Janssens, R. Hofstadter and others. [1962] [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., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 620, Dec. 27, 1962.

New absolute electron-proton cross sections have been measured at values of the momentum transfer squared (q^2) up to 32 F^{-2}. The data at large angles and energies provide new information on a possible flattening of the cross sections previously reported (see item no. 2762, Vol. V). Indications are that the flattening is less than previously thought by about 1 standard deviation and is on the borderline of experimental error. The new cross sections have been combined to yield new values of proton form factors for large q^2 up to 30 F^{-2}. The extended form factors are compared to the Clementel-Villi double-resonance theoretical model.

2868

Stanford U. High-Energy Physics Lab., Calif.

POSSIBLE EVIDENCE FOR A RETARDATION TERM IN LOW-ENERGY π^0 PHOTOPRODUCTION, by D. J. Drickey and R. F. Mozley. [1962] [7]p. incl. diagrs. table. (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. 8: 291-292, Apr. 1962.

Polarized bremsstrahlung was used to study the asymmetry of π^0 photoproduction perpendicular and parallel to the electric vector at 235 mev (120), 285 mev (90) and 335 mev (60). Significant disagreement with theory at 235 mev points to possible contributions of retardation-like terms due to ρ and ω mesons.

2869

Stanford U. High-Energy Physics Lab., Calif.

PRECISE NEUTRON AND PROTON FORM FACTORS AT LOW MOMENTUM TRANSFERS, by D. J. Drickey and L. N. Hand. [1962] [4]p. incl. diagrs. tables, refs. [Rept. no. HEPL-281] (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. 9: 521-524, Dec. 15, 1962.

An attempt to determine the neutron charge form factor G_{Ep} by measuring precise values of the ratio of elastic electron-deuteron scattering to the elastic electron-proton scattering, was made in the range of momentum transfer $0.3 \leq q^2 \leq 2.2 F^{-2}$. The experimental procedure employed a beam of electrons from the Stanford linear accelerator which pass through an Al cup containing either liquid hydrogen or deuterium into an efficient Faraday cup. Scattered electrons were detected in a Cerenkov counter after passing through a magnetic spectrometer. The results obtained were $G_{En} = 0.00 + 0.01$ for $0.3 \leq q^2 < 2.2 F^{-2}$, and at $q^2 = 1.6 F^{-2}$, G_{Ep} was deduced to be 0.850 ± 0.010. The ratio of the rms magnetic and electric radii is unity to within 4%. Many corrections were employed and agreement was obtained with a value of G_{Ep} from a previous accurate determination.

2870

Stanford U. High-Energy Physics Lab., Calif.

STUDY OF NUCLEAR MAGNETIC TRANSITIONS BY INELASTIC ELECTRON SCATTERING, by W. C. Barber, J. Goldemberg and others. [1962] [21]p. incl. diagrs. tables, refs. (Rept. no. HEPL-276) (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. 41: 461-481, Mar. 1963.

The energy spectrum of inelastically scattered electrons at 180° was measured for 41.5 mev electrons from the Stanford Mark II Linear Accelerator for the following elements: $_1D^2$, $_3Li^6$, $_3Li^7$, $_7N^{14}$, $_8O^{16}$, $_9F^{19}$, $_{10}Ne^{20}$, $_{11}Na^{23}$, $_{12}Mg$, $_{13}Al^{27}$, $_{15}P^{31}$, $_{16}S^{32}$, $_{18}Ar^{40}$, $_{19}K^{39}$, $_{20}Ca^{40}$ and $_{83}Bi^{209}$. Some of the elements investigated show clear evidence of excitation of nuclear levels. It is shown that these excitations are most likely due to magnetic dipole transitions. The experiment was performed under conditions in which the "long wave approximation" is approximately valid, so radiation widths were derived for the excited states. A comparison is made with the single particle model predictions. A systematic behavior of some M1 transitions in light nuclei suggested recently by Kurath is supported by the data.

The radiation tail was investigated in some detail and the large-angle bremsstrahlung formula of McCormick, Keiffer and Parzen was found to agree with the data for gas targets. (Contractor's abstract)

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Stanford U. High-Energy Physics Lab., Calif.

DETERMINATION OF THE DEUTERON FORM FACTOR FROM COHERENT π^0 PHOTOPRODUCTION, by J. I. Friedman and H. W. Kendall. [1962] [6]p. incl. diagrs. tables, refs. (Rept. no. HEPL-273) (AFOSR-J488) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under Nonr-22567) AD 407863
Unclassified

Also published in Phys. Rev., v. 129: 2802-2807, Mar. 15, 1963.

Coherent photoproduction of π^0 mesons from deuterium has been used to measure the deuteron form factor. Measurements of the production cross section were carried out for photon energies from 470 to 514 mev by detecting momentum-analyzed recoil deuterons. These measurements were analyzed in terms of the impulse approximation calculation of Hadjioannou. The deuteron form factor has been determined in the range of momentum transfers from 1.74 to 2.74 F^{-1}. The results are consistent with the predictions of a repulsive core potential; however, there is some ambiguity in the interpretation due to the uncertainty in the magnitude of the multiple scattering corrections to the impulse approximation. Measurements of the cross section were also made as a function of photon energy for 2 constant momentum transfers, 1.76 and 1.96 F^{-1}. The range of energies covered was 300 to 500 mev. The results indicate that there is a large reduction of the cross section with respect to the impulse approximation prediction near the (3,3) resonance. This is in qualitative agreement with calculated corrections arising from multiple scattering of the meson in the deuteron. The measurements show that this deviation decreases as the photon energy increases in the region above resonance. (Contractor's abstract)

2872

Stanford U. High-Energy Physics Lab., Calif.

UPPER LIMIT OF THE ELECTRIC DIPOLE MOMENT OF THE ELECTRON, by J. Goldemberg and Y. Torizuka. Aug. 24, 1962 [5]p. incl. diagr. table. (Rept. no. HEPL-268) (AFOSR-J489) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under Nonr-22567) AD 407861
Unclassified

Also published in Phys. Rev., v. 129: 2580-2581, Mar. 15, 1963.

A new upper limit on the electric dipole moment of the electron is established by measurements of the scattering of electrons by He^4 at 180° where the charge scattering is zero. The experiment was performed at a momentum transfer of $q = 0.44 \times 10^{13} cm^{-1}$ and indicate that the electric dipole moment of the electron is $\leq 10^{-15}$ e cm, where e is the charge of the electron. (Contractor's abstract)

2873

Stanford U. High-Energy Physics Lab., Calif.

MAGNETIC ELASTIC SCATTERING OF ELECTRONS BY LIGHT NUCLEI, by J. Goldemberg and Y. Torizuka. [1962] [16]p. incl. diagrs. table, refs. (Rept. no. HEPL-269) (AFOSR-J524) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [Nonr-22567]) Unclassified

Also published in Phys. Rev., v. 129: 312-315, Jan. 1, 1963.

The elastic scattering of 41.5-mev electrons was measured at ~180° where the charge scattering is very small so magnetic scattering stands out more clearly. Measurements were made for $_1H^1$, $_1D^2$, $_2He^4$, $_3Li^6$, $_3Li^7$, $_4Be^9$, $_5B^{10}$, $_5B^{11}$, $_6C^{12}$, $_7N^{14}$, $_8O^{16}$, $_9F^{19}$, $_{10}Ne^{20}$, $_{11}Na^{23}$, $_{12}Mg$, $_{13}Al^{27}$, $_{15}P^{31}$, $_{18}Ar^{40}$, $_{19}K^{39}$, and $_{20}Ca^{40}$. It is shown that the results are consistent with calculations based on scattering by the magnetic moment of the nuclei involved.

2874

Stanford U. High-Energy Physics Lab., Calif.

ANNIHILATION IN FLIGHT OF 200 AND 800 MEV POSITRONS, by A. Browman and J. Pine. [1962] [6]p. incl. diagr. table, refs. (Rept. no. HEPL-266) (AFOSR-J543) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under Nonr-22567) AD 408015
Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 850-855, Feb. 16, 1963.

The total cross-sections for annihilation in flight of 200 and 800 mev positrons have been measured. The ratio of the 2 cross-sections has been determined to an accuracy of 2.5% and is in accord with theory, while their absolute values are about (5 ± 2.5)% low. From the measured ratio, there is no evidence for a deviation from theory which depends on the momentum transfer. The possible discrepancy in absolute value may arise from systematic corrections to the experiment. (Contractor's abstract)

2875

Stanford U. High-Energy Physics Lab., Calif.

INELASTIC ELECTRON SCATTERING STUDIES: Cu^{63}, In^{115}, Ta^{181}, Pb^{208}, AND Bi^{209}, by H. W. Kendall and J. Oeser. [1962] [14]p. incl. diagrs. table, refs. (Rept. no. HEPL-282) (AFOSR-J647) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under Nonr-22567) Unclassified

Also published in Phys. Rev., v. 130: 245-258, Apr. 1, 1963.

Measurements were made of the cross sections for scattering of electrons of primary energies from 183 mev to 600 mev from Cu^{63}, In^{115}, Ta^{181}, Pb^{208}, and Bi^{209}, using high-resolution detectors. A number of E2, E3, E4, and two E5 transitions were induced with nuclear excitations up to 7 mev. The levels excited have enhanced gamma-decay rates to the nuclear ground states. In the odd-A nuclei most of the observed transitions were to clusters of near-similar states. The results are compared in detail to studies of (p, p'), (d, d'), (a, a'), and (n, n') reactions in the same nuclei. Great similarities between these and the (e, e') are established. It is shown how the combined results can be used to determine the disposition and intensities of the levels within the clusters and how these are related to the discrete-energy core excitations in neighboring even-even nuclei. Data taken at high momentum transfer show that inelastic electron scattering continues to be dominated by excitation of collective states in disagreement with predictions based on present understanding of the process. Excitations seen in both Bi^{209} and Pb^{208} at about 5.8 mev are identified as leading to collective states in these nuclei. They are probably E5 transitions although E4 assignments cannot be excluded. The collective states are not seen in Ta^{181} and Au^{197} in (e, e').

2876

Stanford U. [High-Energy Physics Lab.] Calif.

ELASTIC SCATTERING OF HIGH-ENERGY POSITRONS FROM HYDROGEN COBALT, AND BISMUTH (Abstract), by D. Yount and J. Pine. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [Nonr-22567]) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 46, Jan. 24, 1962.

A beam of about 4×10^8 positrons per second has been obtained with energy 300 mev (or lower) and energy spread ± 1%. Elastic scattering of positrons relative to electrons has been measured for hydrogen at 200 mev, 30°; 300 mev, 30°, 45°, and 130°. Scattering at 300 mev has also been measured for cobalt at four angles between 10° and 40° and for bismuth at 6 angles between 5° and 45°. The data are characterized by the ratio R, defined as $[(d\sigma/d\omega)_- - [(d\sigma/d\omega_+]/(d\sigma/d\omega)_- + (d\sigma/d\omega)_+]$, where the - and + subscripts refer to electron and positron cross sections. In first Born approximation R = 0. However, interference between 2-photon and 1-photon Feynman diagrams changes sign for electron scattering relative to positron scattering. Hence, R yields information about 2 photon exchanges, and depends on the static charge distribution of the nucleus as well as on dynamical effects such as nucleon polarizability. The experimental results will be presented and discussed.

2877

Stanford U. High-Energy Physics Lab., Calif.

EXCITATION OF ISOMERIC STATES IN Rh^{103} AND In^{115} BY ELECTRONS (Abstract), by T. H. Crawford, J. Goldemberg, and W. C. Barber. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [Nonr-22567]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 604, Dec. 27, 1962.

Yield curves for the production of the 54-min isomeric state of Rh^{103} and the 4.5-h state of In^{115} were measured both for electrons and bremsstrahlung of energies between 5 and 40 mev. The electrons were produced by the Mark II Stanford linear accelerator, and the irradiations were made with the usual "stacked-foil" method. The ratio of electron/photon yield is sensitive to the multipole character of the absorption process. The results show that the absorption mechanism in the reactions $Rh^{103}(\gamma, \gamma')Rh^{103*}$ and $In^{115}(\gamma, \gamma')In^{115*}$ is dominantly electric quadrupole up to about 10 mev and changes to dipole for energies greater than that. This behavior of the cross section explains the 2 resonances found previously in the cross sections for the above reactions. The reactions $Rh^{103}(\gamma, 2p)Tc^{101}$ and $Rh^{103}(\gamma, 2n)Rh^{101}$ were also measured during the course of the experiment.

2878

Stanford U. [High-Energy Physics Lab.] Calif.

PHOTOPRODUCTION OF π MESONS FROM HYDROGEN AND DEUTERIUM (Abstract), by M. Bazin and J. Pine. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [Nonr-22567]) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 48, Jan. 24, 1962.

Differential cross sections for π^+ photoproduction from hydrogen have been measured for photon energies from 165 to 200 mev. The mesons are identified by momentum and range, as determined by a magnetic spectrometer and counter telescope. At 180-mev photon energy, the angular distribution from 30 to 150° in the center-of-mass system has been measured. Data at higher photon energies does not include the forward angles, while at lower energies the backward angles are inaccessible. The final accuracy is expected to be ≤ 5% relative uncertainties and about 5% absolute uncertainty. The π^-/π^+ ratio from deuterium has also been measured for a similar range of angles and photon energies. In this case, the mesons are identified by momentum and dE/dx, to avoid possible bias from the asymmetrical behavior of stopped pions. The final uncertainties of the measured ratios are expected to be ≤ 5%. The results will be presented and discussed.

2879

Stanford U. Microwave Lab., Calif.

REVIEW OF THE INTERACTION BETWEEN THE GEOMAGNETIC FIELD AND THE SOLAR CORPUSCULAR RADIATION, by R. Blum. Nov. 1962, 69p. incl. diagrs. refs. (ML rept. no. 975) (AFOSR-4531) (AF 49(638)342) AD 294947 Unclassified

The interaction between the geomagnetic field (GMF) and the solar corpuscular radiation (SCR) is investigated. Particular attention is given to the effect of variations of the SCR on production of geomagnetic storms and auroras and to the subject of an interface separating the GMF from the SCR. Mathematical treatment of 3 models for the GMF-SCR interaction are presented.

2880

Stanford U. Microwave Lab., Calif.

NONLINEAR THEORY OF PLASMA OSCILLATIONS, by P. A. Sturrock. Jan. 1962 [25]p. incl. refs. (ML rept. no. 874) (AFOSR-1996) (AF 49(638)415) AD 404797 Unclassified

The nonlinear properties of electrostatic waves in a uniform, zero-temperature plasma free from magnetic field are investigated by 2 independent perturbation procedures. The first of these is the derivative-expansion technique, applied to the Lagrangian variable formalism. The second is a canonical-transformation procedure based on a Hamiltonian description. Both procedures lead to the same formula for the dominant (four-wave) interaction process. If the spectrum is 1-dimensional, the wave interaction vanishes. In general, the effect of wave interactions may be divided into 'coherent' and 'incoherent' contributions. The former leads to a frequency displacement which may be characterized by a dispersion relation. This is evaluated for a test wave in a thermally excited plasma and found to be of the standard form. (Contractor's abstract, modified)

2881

Stanford U. Microwave Lab., Calif.

FERRIMAGNETIC RELAXATION MEASUREMENTS AND MICROWAVE CIRCUIT PROPERTIES OF FERRITE ELLIPSOIDS, by L. K. Anderson. Feb. 1962 [170]p. incl. illus. diagrs. tables, refs. (ML rept. no. 880) (AFOSR-2121) (AF 49(638)415) AD 612628 Unclassified

The object of this paper is to describe the results of an experimental investigation of relaxation processes in microwave ferrites. A new experimental procedure has been developed in which the contribution of the uniform precessional mode to the relaxation may be separated from that of the other spin modes by controlling the interaction between the ferrite sample and its microenvironment. In contrast to previous theories, the results are valid even when the interaction is large, provided that the sample is not too close to a waveguide wall. This "wall effect," which takes the form of a shift, broadening and distortion of the resonance line, is discussed in some detail.

2882

Stanford U. Microwave Lab., Calif.

PLASMA SHEATH FORMATION BY RF FIELDS, by H. S. Butler and G. S. Kino. July 1962, 31p. incl. illus. diagrs. (ML rept. no. 917) (AFOSR-2998) (AF 49(638)415) AD 283839 Unclassified

Also published in Phys. Fluids, v. 6: 1346-1355, Sept. 1963.

It has been observed experimentally that the application of a radio-frequency voltage (10 kc/sec-50 mc/sec) to any one of several electrode configurations around the outside of a plasma discharge tube results in a constriction of the luminous portion of the plasma away from the inner walls of the glass tube. This investigation has established that the phenomenon is basically a radio-frequency rectification effect, leading to the formation of thick ion sheath. The interaction is described mathematically in terms of a differential equation which has an approximate solution that fits qualitatively all the observed characteristics of the phenomenon. The differential equation, in its most general form, has also been solved numerically and the solution is shown to quantitatively fit experimental observations for both radio-frequency sine and square wave signals. An application of this phenomenon as a possible external diagnostic probe technique is proposed. (Contractor's abstract)

2883

Stanford U. Microwave Lab., Calif.

INTERACTION OF MICROWAVES WITH MATTER, by M. Chodorow. Final rept. June 1962, 29p. incl. illus. diagrs. refs. (ML rept. no. 927) (AFOSR-3000) (AF 49(638)415) AD 284055 Unclassified

This report constitutes the general summary on the

investigation of the "Interaction of Microwaves with Matter." Some of the topics discussed are: nonlinear theory of plasma oscillations, plasma sheath formation by RF fields, and microwave properties of ceramic nonlinear dielectrics. Also included are the progress reports of the projects during the final quarter, such as: ferrimagnetic resonance in ferrites, noise in plasmas, and plasma diagnostic techniques.

2884

Stanford U. Microwave Lab., Calif.

FOLDOVER IN DIODE-LOADED RESONANT CIRCUITS, by R. E. Tokheim. Aug. 1962, 31p. incl. diagrs. (AFOSR-4829) (AF 49(638)415) AD 407128 Unclassified

Experimental investigation of foldover was made in a medium frequency series resonant circuit using 2 back-to-back Varicap diodes. Foldover of this nature is a phenomenon of some importance in several practical devices, including bistable switching circuits, the parametron, the parametric limiter, the parametric amplifier and the harmonic generator. The purpose of this study was to determine how well such foldover could be predicted from theory for the series circuit. Theoretical results were based upon precise measurements of the individual circuit components. Very good agreement of theory with experiment was obtained, assuming only the fundamental frequency term in the harmonic balance method of solving the nonlinear differential equation. (Contractor's abstract)

2885

Stanford U. [Microwave Lab.] Calif.

TEMPERATURE DEPENDENCE OF THE WIDTH OF THE R LINE OF CHROMIUM IN MgO (Abstract), by G. F. Imbusch, G. B. West and others. [1962] [1]p. [AF 49(638)415] Unclassified

Presented at meeting of the Amer. Phys. Soc., Stanford U., Calif., Dec. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 613, Dec. 27, 1962.

The width of the cubic-site R line (6981 A) of a chromium-doped MgO crystal has been measured at different temperatures from 4.2°K to room temperature. The spectrometer used was an Ebert grating spectrograph built by the Jarrell-Ash Company. The linewidth increases with temperature in a manner similar to that found for the R line of chromium in ruby. The increase with temperature is a little greater in the case of MgO than for aluminum oxide whose lattice is harder. Since the chromium ion in MgO is in a site of cubic symmetry, the theories of thermal line broadening should be more easily applied to the fluorescence line of chromium-doped MgO than the ruby fluorescence. The shift in the position of the center of the R line with temperature has also been measured in the same temperature range. The line is found to move to the red by about 9 A from 77° to 273°K.

2886

Stanford U. Microwave Lab., Calif.

EVEN AND ODD INSTABILITIES IN COUPLED FERRITE SPHEROIDS, by B. A. Auld and C. H. Holmes. Oct. 1962. [3]p. incl. illus. diagr. (ML rept. no. 968) (AF AFOSR-62-343) Unclassified

Presented at the Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Published in Jour. Appl Phys., v. 34: 1277-1279, Apr. 1963.

A theoretical analysis supported by experimental evidence shows that coupling between 2 ferrimagnetic ellipsoids can lead to a type of instability analogous to the second-order, Suhl spin-wave instability in a single sample. Two ferrite samples coupled through their dipolar fields constitute a pair of coupled non-linear resonators. If the samples are identical, the uniform precession of the system is describable in terms of an even mode in which the transverse components of magnetization in the 2 samples are parallel, and an odd mode in which the transverse components are antiparallel. The frequency separation of these modes is determined by the strength of the coupling. At sufficiently low power levels the even and odd modes are independent, and the response of the system to a driving field exhibits the usual double-peaked shape characteristic of coupled linear resonators. At high power levels, however, nonlinear terms, arising primarily from shape anisotropy, produce significant mode interaction. If, for example, the even mode is excited to a large amplitude at ω_p by applying identical driving fields to the 2 samples, there results a torque at $2\omega_p$ that can lead to exponential growth of the odd mode. Conversely, excitation of the odd mode to a large amplitude can lead to parametric excitation of the even mode. The theoretical analysis predicts the conditions under which growth is attained. Experiments conducted on narrow linewidth disks of single-crystal YIG are in substantial agreement with the theory. The instability is observed as saturation of the directly driven mode and as radiation from the unstable mode. (Contractor's abstract)

2887

Stanford U. [Microwave Lab.] Calif.

SOLUTION OF THE FULL PLASMA-SHEATH EQUATION (Abstract), by S. A. Self and G. S. Kino. [1962] [1]p. [AF AFOSR-62-343] Unclassified

Presented at meeting of the Amer. Phys. Soc., Boulder, Colo., Oct. 10-12, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 631, Dec. 27, 1962.

In the theory of the plasma of an arc, Tonks and Langmuir and later workers assume exact space-charge neutrality. Thus, they ignore the derivative term in the full-plasma-sheath equation and solve the resulting plasma-integral equation, obtaining solutions applicable to the body of

the plasma, but which become progressively inaccurate as the boundary is approached. A solution for the sheath region ignoring ion generation is then matched at some point near the limit of the plasma solution. This procedure gives rise to some uncertainties, since the selection of the matching point, i.e., the plasma-sheath boundary, is rather arbitrary. To overcome these uncertainties, the full plasma–sheath equation has been solved numerically for the plane symmetric discharge with long ion mean free path. Solutions are presented for various values of the discharge parameters. These solutions apply throughout the plasma and sheath regions and, thus, avoid the arbitrary choice of a plasma-sheath boundary.

2888

Stanford U. Microwave Lab., Calif.

VARIATIONAL TECHNIQUE FOR DETERMINING DISPERSION RELATIONS IN PLASMA SYSTEMS, by E. M. Barsten. [1962] [6]p. incl. diagrs. (ML rept. no. 981) (AF AFOSR-62-343) Unclassified

Published in Phys. Fluids, v. 6: 828-833, June 1963.

Sturrock's variational principle seems particularly well suited to the study of small-amplitude disturbances of plasma systems and is formulated in a sufficiently general manner so as to be applicable to relativistic as well as nonrelativistic multistream problems. The use of this variational principle is shown to be effective (in conjunction with the trial-function method) in approximating dispersion relations. To this end the variational procedure is applied to 2 simple plasma problems which admit of exact solution. It is found that a first-order error in the trial functions leads to only a second-order error in the dispersion relation–a behavior typical of variational procedures and which renders them so useful. (Contractor's abstract)

2889

Stanford U. Microwave Lab., Calif.

BLACK-BODY DISTRIBUTION LAW IN SEMI-CLASSICAL RADIATION THEORY, by J. H. Eberly. Apr. 1962, 81p. incl. diagrs. (ML rept. no. 940) (AFOSR-3427) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 282148 Unclassified

A formalism is developed, employing an improved semi-classical theory of electrodynamics, with which it is possible to treat interacting systems of radiation and large or small numbers of atoms. The theory differs from the ordinary semi-classical theory as it is most commonly employed in 2 ways: (1) The neoclassical theory takes consistent account of the effect of the atoms on the electromagnetic fields, as well as the effect of the fields on the atoms. (2) The neoclassical theory avoids the use of perturbation theory in the usual sense, and does not introduce the concept of transition probability. The neoclassical theory is based on the attempt to integrate Schrodinger's equation directly.

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Stanford U. Microwave Lab., Calif.

GENERATION OF SUB-MILLIMETER RADIATION BY A BUNCHED BEAM OF RELATIVISTIC ELECTRONS, by P. A. Szente. July 1962, 126p. incl. diagrs. refs. (ML rept. no. 935) (AFOSR-3428) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 282146 Unclassified

The interaction of a bunched beam of relativistic electrons with several different microwave circuits was analyzed, with a view toward the generation of electromagnetic radiation in the sub-millimeter wavelength region. Because of relativistic effects, it was possible to use structures which had dimensions large compared to the desired wavelength. A relativistic electron beam was obtained from a traveling-wave linear accelerator which operated at a frequency of 9288 mc/sec. The interaction properties predicted by theory were compared with the experimental results obtained from resonant cavities, from a dielectric-loaded slow-wave structure, and from 2 other special structures: a magnetic undulator and a sinuous waveguide. In the case of the magnetic undulator, approximately 150 mw were generated at 5.4 mm, and 35 mw at 1 mm. The shortest wavelength observed was 0.4 mm at a power level of 40 μw.

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Stanford U. Microwave Lab., Calif.

THE MICROWAVE CHARACTERISTICS AND APPLICATIONS OF FERROELECTRIC CERAMICS, by M. DiDomenico, Jr. Oct. 1962, 151p. incl. illus. diagrs. table, refs. (ML rept. no. 960) (AFOSR-5013) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 292131 Unclassified

The purpose of this investigation was to study both theoretically and experimentally the uses of ferroelectric ceramics in microwave device applications. At microwave frequencies, ferroelectric ceramics behave as nonlinear dielectrics and exhibit small signal as well as large signal scaler nonlinear characteristics in both the dielectric constant and the rf dielectric conductivity. The preliminary part of this study gives a comprehensive review of the experimentally measured characteristics of the ferroelectric titanates, and in particular of the ceramic 73% BaTiO3 -27% SrTiO3. An X-band electrically tunable ferroelectric phase shifter was constructed. Phase shifter was controlled by applying a dc electric field to the ferroelectric. The measured characteristics of this device showed that phase shifts of 40° - 50° are attainable over a 400 mc band centered about 9.3 kmc with insertion losses ranging from 2 - 6 db. The general incremental behavior of such small signal devices as phase shifters, attenuators, and tunable cavities is also discussed. The non-linear behavior of the 73% BaTiO3 - 27% SrTiO3 ceramic was further used to construct a harmonic generator operating from 3 to 9 kmc. In order to assess the characteristics of ferroelectric traveling-wave harmonic generators, an example is worked out for an S-band TE sub-10 mode at the fundamental frequency of 3 kmc.

2892

Stanford U. Microwave Lab., Calif.

COUPLED MODE THEORY OF ACOUSTIC WAVE AMPLIFIERS, by C. F. Quate. Feb. 1962, 35p. incl. diagrs. (ML rept. no. 889) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 292329 Unclassified

It has recently been demonstrated that acoustic waves can be amplified in CdS when the free carriers in the photoconductor drift through the crystal with a velocity somewhat faster than sound. The acoustic waves generate an electric field which couples to the carriers in piezoelectric materials. The coupled mode theory of interactions of this type is discussed. The propagation characteristics of the waves in the elastic media and the waves on the drifting carriers are changed when the normal modes in the 2 systems are weakly coupled with the piezoelectric field. With this coupling, and with the case where the diffusion current is less than the current of the bunched carriers, we find 1 forward wave growing exponentially and a second wave attenuating exponentially with distance. The boundary conditions are studied and show that the amplified wave is strongly excited by the elastic wave at the input. The analysis presented should be valid in the range of frequencies where the mean free path of the carriers is short compared to the acoustic wavelength. (Contractor's abstract)

2893

Stanford U. Microwave Lab., Calif.

EFFECTS OF ELECTRON BEAM CONFINEMENT ON KLYSTRON EFFICIENCY, by C. G. Nelson. Apr. 1962, 97p. incl. diagrs. tables, refs. (ML rept. no. 910) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 276503 Unclassified

The effects of magnetic field configuration on klystron efficiency were measured, especially the effects of introducing magnetic flux at the cathode, leading to so-called confined flow in the electron beam. The experiments were performed using a 2-cavity klystron of special design, incorporating a movable output cavity and a scanning iris. The scanning iris permitted measurements of dc and rf current distribution in the beam; longitudinal movement of the cavity made these measurements possible at various axial positions and allowed the determination of optimum cavity spacing. Detailed studies were made on 4 beams requiring magnetic focusing fields of up to twice the Brillouin field. Detailed current distributions in these beams were used in determining various parameters useful in analyzing klystron performance, such as plasma wavelength, beam coupling coefficients, and beam loading conductance. (Contractor's abstract)

2894

Stanford U. [Microwave Lab.] Calif.

FLUORESCENCE SPECTRA OF CHROMIUM IONS IN α AND β GALLIUM OXIDE (Abstract), by G. F. Imbush, A. L. Schawlow, and J. P. Remeika. [1962] [1]p. (In cooperation with Bell Telephone Labs., Inc.) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 445-446, Aug. 27, 1962.

Fluorescence of Cr^{3+} ions has been observed at low ion concentrations in both α and β crystalline forms of gallium oxide. In both cases, the R_1 line (^2E, $\bar{E}$–$^4A_2$) and the R_2 line (^2E, $2\bar{A}$–$^4A_2$) were observed with a Hilger wavelength spectrometer modified to have a dispersion of 2.3 A/mm. The spectrum of Ga_2O_3:Cr^{3+} which has been reported previously is that of the β form which was prepared by crystallization from a flux. It has fluorescence lines R_1 at 6885 A and R_2 at 6950 A (at 77°K). αGa_2O_3 has a simple crystal structure (isostructural with αAl_2O_3); the Cr^{3+} fluorescence lines are at 6859 and 6943 A. The sample was prepared by heating the monohydrate in air. The spectrum is quite similar to that of pink ruby, while the larger ^2E splitting of the β form is probably caused by tetragonal and rhombic components of the crystal field.

2895

Stanford U. [Microwave Lab.] Calif.

MONOCHROMATIC RUBY OPTICAL MASER (Abstract), by L. F. Mollenauer, G. F. Imbusch and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 445, Aug. 27, 1962.

An ideal optical maser would generate light that is truly monochromatic. Preferably the wavelength should be determined by some atomic resonance, rather than by structural dimensions. However, most optical masers use highly reflecting end plates and so have strong, closely spaced, axial-mode resonances. Typically maser oscillation occurs simultaneously in several axial modes, so that the output contains several frequencies. Ordinarily, the atomic linewidth is broad enough to include a number of axial modes, and the exact output wavelengths are determined by the cavity resonances. However, ruby at 77°K has very strong,

narrow fluorescence lines ($\Delta\nu \sim 0.2$ cm^{-1}), and so the maser can be operated with one end unsilvered. The, the output wavelength is determined by the spectral line. By using a sapphire-clad rod immersed in liquid nitrogen, a single sharp line has been obtained. Its width was determined using the tilted-plate interferometer to be less than 0.0025 cm^{-1} near the threshold.

2896

Stanford U. [Microwave Lab.] Calif.

MULTIPLE BEAM INTERFEROMETRY WITH LARGE PLATE SEPARATIONS (Abstract), by H. W. Moos, G. F. Imbusch and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 445, Aug. 27, 1962.

The use of multiple-beam interferometry for detailed studies of surface contours has been confined to reflectors almost in contact. With truly monochromatic, parallel optical-maser light sources, it is now possible to extend it to large plate separations. The experimental arrangement is equivalent to a Fabry-Perot interferometer with 1 plate tilted a few wavelengths from parallelism. Monochromatic light entering perpendicular to the plates is transmitted at those places where the plate spacing is $n\lambda/2$. The interference fringes can be photographed either with or without focusing. If the plates are flat and the medium homogeneous, they are straight lines; otherwise the fringes are curves, but still very sharp if the reflectivity is high. If several wavelengths are present, fringes appear between the orders. Thus, the tilted-plate interferometer can be used for high-resolution spectroscopy of collimated sources, even if the plates are not very flat. It can also exhibit sensitively variations in refractive index of the medium between the plates.

2897

Stanford U. Microwave Lab., Calif.

NORMAL MODE THEORY FOR ELECTRON-BEAM PLASMA AMPLIFICATION, by M. Chodorow, J. C. Eidson, and G. S. Kino. [1962] [5]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Also published in Microwave: Proc. Fourth Internat'l. Cong. on Microwave Tubes, Scheveningen (Netherlands) (Sept. 3-7, 1962), Eindhoven, Centrex Publishing Co., 1963, p. 333-337.

It is the purpose of this paper to show that a variational technique, based on a trial function with the same radial variation of the field over the beam plasma system as the cold of the plasma, is quite adequate to obtain good agreement with field theory solutions as determined by Allen et al. The variational method also makes it possible to obtain a far better physical insight into the type of coupling that occurs in the beam plasma system. Using the quasi-static approximation, a variational expression for the propagation constants in terms of the potential function has been obtained for a beam plasma system with finite geometry and magnetic field. Using the unperturbed static modes of the plasma as trial functions, dispersion diagrams were obtained which agree reasonably well with the more exact numerical solutions. This method gives more insight into the nature of the interaction.

2898

Stanford U. Microwave Lab., Calif.

PARAMETRIC [REFREGERATION] DISCUSSION AND EXPERIMENTAL VERIFICATION OF THE REMOVAL OF SLOW-WAVE NOISE, by P. A. Sturrock, G. C. van Hoven, and A. Karp. [1962] [5]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Published in Microwaves: Proc. Fourth Internat'l. Cong. on Microwave Tubes, Scheveningen (Netherlands) (Sept. 3-7, 1962), Eindhoven, Centrex Publishing Co., 1963, p. 231-235.

As a first attempt at the realization of a parametrically refrigerated amplifier, the noise removal coupler has been investigated experimentally. Parametric coupling to circuit waves was directly demonstrated and indirectly shown. The exchange of energy between these waves and the slow space-charge wave was indirectly shown. Parametric refrigeration is fundamentally different from all other noise removal processes. Consequently, its use in conjunction with these other methods should allow a substantial reduction in presently available microwave noise figures.

2899

Stanford U. Microwave Lab., Calif.

PUMPING POWER CONSIDERATIONS IN AN OPTICAL MASER, by O. Svelto. Apr. 1962, 29p. incl. diagrs. (ML rept. no. 902) (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under Nonr-22548) Unclassified

Published in Appl. Opt., v. 1: 745-751, Nov. 1962.

Also published in Appl. Opt. Suppl. on Opt. Masers, v. 1: 107-113, 1962.

The theoretical efficiency of various pumping power systems that have been adopted in optical masers is studied. A thermodynamical method is used to calculate the power transferred from the flashtube to the maser material. In this way a general expression is obtained which allows one to calculate the total power and the power per unit area of the flashtube needed, for a given power absorption by the active rod. When the rod is

surrounded by a sheath with an index of refraction equal to or greater than that of the rod, the power per unit area of the flashtube is lowered at best by the factor n, where n is the index of refraction of the rod. The total power required from the flashtube is not affected by the sheath. The most efficient case occurs when the pumping power is allowed to enter the active rod from all directions. In this case the necessary power per unit area of the flashtube is reduced by a factor n^2 with respect to the case of a simple rod. (Contractor's abstract)

2900

Stanford U. Microwave Lab., Calif.

SPIN-WAVE RESONANCE IN THIN FILMS AT OBLIQUE ANGLES, by T. D. Rossing. [1962] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Presented at the Eighth Symposium on Magnetism and Magnetic Materials, Pittsburgh, Pa., Nov. 12-15, 1962.

Published in Jour. Appl. Phys., v. 34: 1133-1134, Apr. 1963.

Spin-wave spectra in thin Permalloy films have been observed as the angle between the applied field and the film is varied from 0 to 90°. The applied field corresponding to the main resonance peak falls very close to its calculated value for all angles. At some critical angle the spin-wave spectrum collapses to a single peak. The observed critical angle is very near the angle at which the resonance frequency becomes independent of small changes in the magnetization, which supports a dynamic-pinning model. The separation between the main peak and the subsidiary peaks reaches a maximum at an angle slightly less than the critical angle and drops sharply as the critical angle is approached. At no angle does the wavelength of the spin waves appear to be a submultiple of the film thickness as would be expected if the surface spins were completely pinned. As the angle between the applied field and the film increases from 0, the linewidth increases and reaches a maximum near 80°. Beyond this angle the linewidth decreases rapidly, and in many films the linewidth at 90° is less that at 0. Simple theory explains the increase in linewidth with angle, locates the angle of maximum linewidth, but fails to predict the narrowness at 90°. (Contractor's abstract)

2901

Stanford U. Microwave Lab., Calif.

THEORETICAL CONSIDERATIONS ON MILLIMETER WAVE GENERATION BY OPTICAL MIXING, by J. R. Fontana and R. H. Pantell. [1962] [5]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Published in Proc. Inst. Radio Engineers, v. 50: 1796-1800, Aug. 1962.

The generation of radiation by mixing optical maser signals is one possible method for closing the gap between microwaves and infrared. The conversio efficiency attainable with different types of nonlinear media is considered. It is shown that lossless nonlinear media, such as dielectrics, have very low conversion efficiency properties, regardless of the way they are used. Nonlinear resistive media, on the other hand, have efficiencies up to 25%, independently of the frequency conversion ratio. Consequently, in order to generate wavelengths in the millimeter range by mixing optical maser outputs, the materials used should involve nonlinear dissipative processes. (Contractor's abstract)

2902

Stanford U. [Radio Propagation Lab.] Calif.

STANFORD MICROWAVE SPECTROHELIOGRAMS FOR 1960 JULY, by G. Swarup. Mar. 1962, 37p. incl. illus. diagrs. table. (Scientific rept. no. 12; Stanford Radio Astronomy Inst. publ. no. 12) (AFOSR-1604) (AF 18(603)53) AD 275790 Unclassified

Maps are presented of the sun which show the disc distribution of solar radio emission at 9.1-cm wavelength by means of radioisophotes, 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. With the microwave spectroheliograph, the sun is scanned along approximately 15 parallel lines from west to east, and from the resulting records the maps are carefully prepared by hand. A positional accuracy of better than ± 1/2 min of arc in the location of bright features is maintained.

2903

Stanford U. [Radio Propagation Lab.] Calif.

FUTURE LARGE RADIO TELESCOPES, by R. N. Bracewell, G. Swarup, and C. L. Seeger. [1962] [5]p. incl. illus. diagrs. refs. (AFOSR-3051) (AF 18(603)53) Unclassified

Also published in Nature, v. 193: 412-416, Feb. 1962.

As the cost and size of steerable paraboloidal reflectors for radio-telescopes has become prohibitive, some alternative methods for constructing narrow beam instruments are examined. Aerials that can grow would enable observational and constructional work to proceed side by side with less time wastage and some examples are given. A brief review, with reference to the literature, of several narrow beam instruments is made. It is pointed out that the cost of data-handling equipment and computers might equal the cost of the aerials in future large multiple-beam instruments.

2904

Stanford U. [Radio Propagation Lab.] Calif.

A MODEL FOR THE SOURCES OF THE SLOWLY VARYING COMPONENT OF MICROWAVE SOLAR RADIATION, by T. Kakinuma and G. Swarup. [1962] [20]p. incl. diagrs. tables, refs. (AFOSR-J61) (AF 18-(603)53) AD 400438 Unclassified

Also published in Astrophys. Jour., v. 136: 975-994, Nov. 1962.

A comparison of the observations of the slowly varying component of the solar radio emission made with high-resolution interferometers operating at wavelengths of 3.2, 7.5, 9.1, and 10.7 cm shows that the flux densities of many strong sources are higher at the longer wavelengths than at 3 cm. The same conclusion is derived from eclipse and statistical investigations, which indicate further that the spectrum of the flux density has a peak around 6 cm. The decrease in flux density with frequency cannot be explained simply by assuming a greater optical thickness for the extraordinary wave near 10 cm in the million-degree corona, as given by the magneto-ionic theory, since the observed degree of polarization at 7.5 or 9.1 cm is much lower than that at 3.2 cm. It is suggested that radiation at the gyro-frequency and its harmonics emitted by the thermal electrons in the dense region over a sunspot group should be taken into account to explain the spectrum of the slowly varying component. This mechanism of resonance absorption requires the average strength of the magnetic field over the sunspot group to be about 600 gauss at a height of 2×10^4 km above the photosphere and 250 gauss at a height of 4×10^4 km. In order to explain the observed values of brightness temperature of $1\text{-}4 \times 10^6$°K near 10 cm by the magneto-ionic theory, it is necessary to assume values of electron density of up to 20 or 40 times the normal. However, these high values of densities are not required by the gyro-theory, and values of five to ten times the normal are sufficient for explaining simultaneously the observations of brightness temperature flux density, and polarization. This theory also explains the small size of the source in the range 3-10 cm. The radio emission is considered to originate thermally, which requires that the value of the electron temperature in the region of the inner solar corona above a large sunspot group is about $2\text{-}4 \times 10^6$°K. (Contractor's abstract)

2905

Stanford U. Radio Propagation Lab., Calif.

RADIO ASTRONOMY TECHNIQUES, by R. N. Bracewell. [1962] [88]p. incl. illus. diagrs. tables, refs. (AFOSR-J294) (AF 18(603)53) AD 406486 Unclassified

Also published in Handbuch der Phys., v. 54: 42-129, 1962.

The first 2 parts of this chapter, concerned respectively with receivers and aerials, represent a selection from a vast field of radio technology. Parts II and III have been written for the physicist, etc., who would benefit from a collected exposition of the parts of radio technique relevant to his work. Part IV lays the groundwork for studying those parts of radio astronomy technique which have not been borrowed from existing practice but have been developed recently by radio scientists engaged in astronomical observation. It introduces the quantities brightness, brightness temperature, and flux density in terms of which observations are expressed, and sets up the aerial smoothing equation, an integral equation which relates them to available power, the quantity which is actually measurable with a receiver and aerial. Part V describes the simple 2-element interferometer, the radio analog of Michelson's stellar interferometer, and interprets its function as a determination of the complex visibility of a temporal interference fringe system. Part VI of this chapter goes into details of the measurement of radiation fields from celestial sources by means of both pencil beam aerials and interferometers. All the components of the often complex apparatus which is immersed in the field, the concepts necessary for considering its interaction with the field, and the procedures for absolute calibration, are discussed in the preceding parts, and the observing procedures clarified.

2906

Stanford U. [Radio Propagation Lab.] Calif.

CORRECTION FOR GRATING RESPONSE IN RADIO ASTRONOMY, by R. N. Bracewell. [1962] [9]p. incl. tables, refs. (AFOSR-J295) (In cooperation with Sydney U. (Australia)) (AF 19(603)53) AD 408043 Unclassified

Also published in Astrophys. Jour., v. 137: 175-183, Jan. 1963.

Periodic departures from uniform excitation cause certain antennas used for radio astronomy to possess grating responses. As many future large antennas will be of this type, the theory of correcting for grating responses has been developed, though not exhausted. A correction procedure has been derived that gives a rigorous solution under wide conditions. Some important cases are tabulated for reference.

2907

Stanford U. Radio Propagation Lab., Calif.

BROADBAND TUNNEL-DIODE AMPLIFIERS, by B. R. Henoch and Y. Kvaerna. Interim rept. Sept. 1961 - Aug. 1962, 85p. incl. diagrs. (Technical rept. no. 213-2; rept. no. SEL-62-099) (Sponsored jointly by Air Force; and Air Force Office of Scientific Research under AF 18(603)53) AD 299284 Unclassified

A tunnel-diode amplifier can be broadbanded by incorporating the diode in a filter structure where the reactive elements of the diode are part of the filter. This is described as matching the amplifier impedance to a constant-gain circle in the impedance plane. Design

principles are given for amplifiers of this type, and the frequency response is calculated for a few circuits. The results show bandwidths much larger than can be handled by the presently available circulators needed for separating the input and output parts. Reflections from the circulator can easily give rise to oscillation, especially outside the band of interest, because an amplifier with only reactive tuning is active for all frequencies up to the diode cut-off frequency. A solution to this problem is to introduce resistive elements in the amplifier circuit so as to have negligible effect in the band of interest, but to load down the tunnel diode so as to make the whole circuit passive outside this band. The theory of such selective loaded amplifiers is discussed, and several practical realizable circuits are described. (Contractor's abstract)

2908

Stanford U. [Radio Propagation Lab.] Calif.

HOW LARGE CAN A MICROWAVE ANTENNA BE? by R. N. Bracewell. [1962] [5]p. incl. diagrs. (AFOSR-3269) (AF 49(638)1059) Unclassified

Also published in Microwave Jour., v. 5: 57-61, Jan. 1962.

It appears that some of the difficulties associated with the construction of very large antennas are open to solution, and that a move forward to even larger sizes can be expected. Just what other limits to the size of an antenna will occur is not yet clear, but it may be that the future limits will not be inherent in the antenna structures themselves.

2909

Stanford U. [Radio Propagation Lab.] Calif.

HIGH-RESOLUTION STUDIES OF TEN SOLAR ACTIVE REGIONS AT WAVELENGTHS OF 3-21 CM, by G. Swarup, T. Kakinuma and others. [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-J872) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)1059 and National Science Foundation) AD 416018 Unclassified

Also published in Astrophys. Jour., v. 137: 1251-1267, May 15, 1963.

Ten strong sources of the slowly varying component (S-component) of solar radio emission have been studied using high-resolution interferometers operating at wavelengths of 3.2, 7.5, 9.1, 10.7, and 21.1 cm. All the 10 radio sources were associated with sunspot groups having areas greater than about 500 millionths of the solar hemisphere. The observations were obtained with interferometers which are located at Nagoya, Ottawa, Stanford, and Sydney and which provide fan- and pencil-shaped beams having widths of about 1-3 min of arc. This international cooperation has made it possible to study the wavelength dependent of the S-component. It appears that a strong source of the slowly varying component has a higher value of flux density near 10 cm than at 3 cm or 21 cm. The size has a value of about 2-3 min of arc at wavelengths of 3 and 10 cm and about 3-4 min of arc at 21 cm. The calculated values of heights show a large scatter but are of the order of 10000-20000 km at wavelengths of 3 and 10 cm, and about 40000-90000 km at 21 cm. As other eclipse and interferometric observations have shown, the radio emission is circularly polarized, with the degree of polarization being > 30% at 3 cm, ~ 10% at 10 cm, and < 2% at 21 cm. At 10.7 cm, the brightness temperatures of the 10 sources range from 1.6 to 3.8 x 10^6°K when it is assumed that the north-south widths of the sources are equal to the observed east-west widths. The brightness temperatures show good correlation with both sunspot areas and magnetic fields. The above results about the flux-density spectrum and degree of polarization are not consistent with simple magnetoionic theory in which only the effect of electron-ion collisional absorption is considered.

2910

Stanford U. Stanford Electronics Labs., Calif.

DATA SUMMARY: WHISTLER MODE PROPAGATION, by D. L. Carpenter and G. B. Carpenter. Jan. 12, 1962, 30p. incl. illus. tables. (Rept. no. SEL-62-001) (AFOSR-2100) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)126, National Science Foundation, and Office of Naval Research) AD 273528 Unclassified

Routine data on whistler dispersion and on whistler-mode echoes from VLF-pulse transmission are tabulated. Data are sampled on a daily basis. The times of occurrence, values of dispersion at 5 kc, and the frequency and time delay of the whistler nose are tabulated. Data on whistler-mode echoes from VLF station NPG were obtained at Stanford, California. (Contractor's abstract, modified)

2911

Stanford U. Stanford Electronics Labs., Calif.

ELECTRON-DENSITY VARIATIONS IN THE MAGNETOSPHERE DEDUCED FROM WHISTLER DATA, by D. L. Carpenter. Mar. 1962, 28p. incl. illus. diagrs. table, refs. (Technical rept. no. 11; rept. no. SEL-62-042) (AFOSR-2339) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)126 and National Science Foundation) AD 275838 Unclassified

Also published in Jour. Geophys. Research, v. 67: 3345-3360, Aug. 1962.

Electron-density variations in the magnetosphere at a geocentric distance of 2 - 4 earth radii are deduced from whistler observations made, primarily, at Stanford, Calif. and Seattle, Wash. The whistler quantities scaled are frequency and group delay at the whistler nose, and group delay at 5 kc.

2912

Stanford U. Stanford Electronics Labs., Calif.

THE MAGNETOSPHERE DURING MAGNETIC STORMS: A WHISTLER ANALYSIS, by D. L. Carpenter. June 1962, 72p. incl. diagrs. tables, refs. (Technical rept. no. 12; rept. no. SEL-62-059) (AFOSR-2653) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)126 and National Science Foundation) AD 281837 Unclassified

The electron density of the outer ionosphere, or magnetosphere of the earth was studied, using whistlers. The analysis leads to new results, results which have not been predicted by theory or by the relatively small amount of relevant information from satellites. It is shown that (1) ionization density levels in the magnetosphere are substantially depressed during magnetic storms; and (2) the degree of depression may increase rapidly with distance from the earth, thus producing large gradients in ionization density. (Contractor's abstract)

2913

Stanford U. [Stanford Electronics Labs.] Calif.

DISCUSSION OF PAPER BY R. L. DOWDEN, "DOPPLER-SHIFTED CYCLOTRON RADIATION FROM ELECTRONS: A THEORY OF VERY LOW FREQUENCY EMISSIONS FROM THE EXOSPHERE", by N. Brice. [1962] [3]p. incl. illus. table. (AFOSR-J503) (AF 18-(603)126) AD 414599 Unclassified

Also published in Jour. Geophys. Research, v. 67: 4897-4899, Nov. 1962.

Testing parameters are derived which should be equal to unity for any sequence of successive whistler mode echoes of a hook, beginning with the unreflected hook. On applying this test to 4 such sequences, the quantities are quite significantly not unity.

2914

Stanford U. [Stanford Electronics Labs.] Calif.

PERIODIC NOISE ASSOCIATED WITH WHISTLER ECHO TRAINS, OBSERVED AT SPACE STATIONS IN OPPOSITE HEMISPHERES (Abstract), by R. A. Helliwell, J. Katsufrakis and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)126 and National Science Foundation) Unclassified

Presented at URSI-IRE Joint Spring meeting Washington, D. C., Apr. 30-May 3, 1962.

Published in I. R. E. Trans. on Antennas and Propagation, v. AP-10: 492, July 1962.

Whistler recordings from northern and southern hemisphere stations has revealed a remarkable association between whistlers and periodic VLF ionospheric noise (VLF emissions). The phenomenon is illustrated with recordings obtained on October 1, 1961, at 1250 UT during the course of a severe magnetic storm. The spectra from all stations in the same hemisphere are identical, but show the expected "conjugate" anti-phase relationship in opposite hemispheres. The events were not restricted to geomagnetically conjugate pairs of stations but were identified over a large geographical area extended in longitude from Byrd Station to Wellington and in latitude from Stanford to Byrd. The essence of the phenomenon is the development of discrete emissions which appear to grow out of the echoes of a strong whistler. With each successive whistler echo and its associated emission, the parent whistler becomes weaker and finally disappears (after 30 hops). The discrete emission on the other hand is observed to undergo a small but distinct change in form with each echo, so that after many echoes the emission often bears little resemblance to the original form. It is suggested that although the observed noise may be generated by traveling wave amplification, these records indicate that a strong electromagnetic wave traveling in the whistler mode may provide the bunching necessary for coherent, discrete emission from a stream of particles. Thus discrete bunches of charged particles would not be required to produced discrete emissions.

2915

Stanford U. Stanford Electronics Labs., Calif.

NONLINEAR OPTICAL EFFECTS: AN OPTICAL POWER LIMITER, by A. E. Siegman. July 1962, 17p. incl. diagrs. refs. (Technical rept. no. 172-1; SEL-62-085) (AFOSR-2638) (AF 49(638)660) AD 287601 Unclassified

Also published in Appl. Opt., v. 1: 739-744, Nov. 1962.

Parametric subharmonic oscillators and amplifiers at optical frequencies have recently been proposed, using optical maser pump sources together with the nonlinear optical properties of certain crystals. The simplest such structure would comprise a Fabry-Perot resonator filled with nonlinear crystal, the ends being transparent at the fundamental or pump frequency ω and reflecting at the subharmonic frequency $\omega/2$. This paper demonstrates that such a structure will also function as an ideal optical power limiter at the fundamental. Power transmission through the structure at ω will limit sharply and flatly at the threshold level at which subharmonic oscillations commence; a large power-dependent reflection will also occur on the input end above threshold. The use of such a limiter for eliminating spiking in optical masers, and for other purposes, is suggested. (Contractor's abstract)

2916

Stanford U. Stanford Electronics Labs., Calif.

INTERACTION BETWEEN A DIELECTRIC (OR COLD PLASMA) AND A CAVITY, by K. I. Thomassen. [1962] [8]p. incl. illus. diagrs. (Technical rept. no. 251-2; rept. no. SEL-62-092) (AFOSR-4080) (AF 49(638)660) AD 288014 Unclassified

Also published in Jour. Appl. Phys., v. 34: 1622-1629, June 1963. (Title varies)

This paper treats the interaction between a cylindrical plasma column (or dielectric material) and a resonant cavity from which it protrudes. From the results, one may determine the dielectric constant and loss, or in the case of a plasma, the plasma frequency and collision frequency, given measured values of the resonant frequency shift and change in the cavity Q. This theory differs from earlier theory on cylindrical cavities in that it treats a cavity of more general shape, although restricted to TM modes, and takes into account the subtle boundary effects at the openings through which the plasma is admitted. These effects may be calculated by estimating the field variation over the part of the cylindrical plasma surface that lies inside the cavity. (Contractor's abstract)

2917

Stanford U. Stanford Electronics Labs., Calif.

OBSERVATIONS OF COLLECTIVE PHENOMENA IN PLASMAS, by K. I. Thomassen. Oct. 1962, 49p. incl. diagrs. table. (Technical rept. no. 251-3; rept. no. SEL-62-143) (AFOSR-4154) (AF 49(638)660) AD 292797 Unclassified

The objective of this research was to find experimental evidence of an anomalous resistance in plasmas. Anomalous resistance results when collective action by electrons causes randomization of the growing oscillations in the 2-stream instability. This sequence of events leading to dissipation of energy was predicted several years ago by Buneman. It is believed that this objective was achieved (i.e., that anomalous resistance is evidenced by observations to be reported here), on a high density plasma subjected to r-f fields by a cavity resonant at a frequency well below the plasma frequency. With sufficient r-f power and density, the 2-stream instability should be excited to turbulence level during each half-cycle, causing irreversible power loss. Calculations enumerating the necessary conditions for observing the phenomena were made, showing that the resistance can easily be seen above the intrinsic cavity loss using very moderate amounts of power. (Contractor's abstract)

2918

Stanford U. Stanford Electronics Labs., Calif.

INVESTIGATION OF RUBY-OPTICAL-MASER CHARACTERISTICS USING MICROWAVE PHOTOTUBES, by B. J. McMurtry. July 1962, 139p. incl. illus. diagr. tables, refs. (Technical rept. no. 177-3; rept. no. SEL-62-097) (AFOSR-J1312) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)660 and Dept. of Army) AD 289510; AD 424371 Unclassified

Also published in Appl. Opt., v. 2: 767-786, Aug. 1963.

In this analysis, the successful demonstration of a novel experiment testing this proposal is described. This experiment led to the verification of the microwave-phototube proposal, and also provided a powerful tool for studying the spectral output of the ruby laser. The second topic is the application of this method of photoelectric mixing to the study of the ruby laser. Experiments are described which permit conclusions concerning (1) the behavior of the laser's spectral output as a function of pump power and temperature; (2) the validity of applying homogeneous interferometer mode analyses to the case of ruby; and (3) the effects of fluorescence line shape and stimulated emission in determining oscillation frequencies. In addition, they provide extremely high resolution measurements of the oscillation linewidth. (Contractor's abstract)

2919

Stanford U. Stanford Electronics Labs., Calif.

WHISTLER EVIDENCE OF A "KNEE" IN THE MAGNETOSPHERIC IONIZATION DENSITY PROFILE, by D. L. Carpenter. [1962] [8]p. incl. illus. diagrs. refs. (AFOSR-64-0316) (AF 49(638)1060) AD 433075 Unclassified

Also published in Jour. Geophys. Research, v. 68: 1675-1682, Mar. 15, 1963.

Study of a new whistler phenomenon shows that the magnetospheric ionization profile often exhibits a 'knee', that is, a region at several earth radii in which the ionization density drops rapidly from a relatively normal level to a substantially depressed one. The new whistler phenomenon (called, for convenience, the 'knee whistler') is compared with ordinary whistlers and is illustrated by a number of examples recorded at middle- and high-latitude stations. It is suggested that the knee exists at all times in the magnetosphere, and that its position varies, moving inward with increasing magnetic activity. There are indications that conditions of whistler-mode propagation may be unusually favorable on the low-latitude side of the knee and that the region on the high-latitude side may be favorable for the production of triggered ionospheric noise. It is pointed out that knee whistlers account for a substantial number of the observations of deep density depressions during magnetic storms. Several questions of interpretation are raised, and the direction of future investigations is indicated. (Contractor's abstract)

2920

Stanford U. Stanford Electronics Labs., Calif.

EVIDENCE OF ANOMALOUS RESISTANCE IN PLASMAS, by K. I. Thomassen. [1962] [2]p. (AF AFOSR-62-286) Unclassified

Published in Phys. Rev. Ltrs., v. 10: 80-81, Feb. 1, 1963.

The afterglow phase of a pulsed reflex type discharge was examined for evidence of instability arising from electron drifts through a positive ion background. Plasma resistance was inferred from the ratio of incident to reflected power in a 200 mc/s reentrant cavity through which the plasma penetrated. Measurements

in hydrogen at ion densities greater than 10^{12} showed an anomalous increase in resistance with power input, whereas similar measurements in argon were consistent with only very small resistance changes. The results are consistent with instability predictions.

2921

Stanford U. [Stanford Electronics Labs.] Calif.

EXPERIMENTAL OBSERVATIONS OF ANOMALOUS RESISTANCE (Abstract), by K. I. Thomassen. [1962] [1]p. [AF AFOSR-62-286] Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 168-169, Feb. 28, 1963.

Anomalous resistance, due to instabilities rather than collisions, was predicted by Buneman. This resistance is believed to have been observed in a plasma subjected to an electric field at a frequency intermediate between the collision frequency (5 mc) and the plasma frequency (> 30 kmc). The (H) plasma, created in a pulsed reflex discharge, penetrated the gap of a 140-mc re-entrant cavity such that the fundamental mode would cause interstreaming of electrons and ions along the dc magnetic field aligning the column. (The skin depth was approximately 1/3 the column radius.) Given sufficient rf power and density, the 2-stream instability should be excited to turbulence level during each half-cycle, causing irreversible power loss. At low power and density, the plasma should be mainly reactive, except for small losses to individual processes such as collisions. By observing the incident and reflected power into the cavity, we did find resistive loading that increases with power but that does not vary with power at lower plasma densities.

2922

Stanford U. Stanford Electronics Labs., Calif.

COMMUNICATION THROUGH RANDOM MULTIPATH MEDIA, by D. P. Harris. Apr. 1962 [94]p. incl. diagrs. refs. (Technical rept. no. 1002-2; rept. no. SEL-62-031) (AFOSR-3907) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524, and Lockheed Missiles and Space Co.) AD 291447 Unclassified

The performance capabilities of some specific techniques for communicating through noisy, randomly time-varying multipath channels are considered. Analysis is undertaken in sufficient depth to give guidance in the selection of design parameters of various types of systems. The results permit some comparisons to be made of the performance potentials of different communication techniques. Bounds on the communication rate possible with an adaptive matched-filter receiving technique are obtained as functions of the channel-sounding effort, the signal characteristics, and the channel characteristics. These bounds are found to be relatively insensitive to the degree of effort expended in measuring the channel transfer function. The performance characteristics of a class of radiometric signal-detection techniques that require no channel-sounding provisions are analyzed. Detailed design equations and graphs for determining and optimizing performance of such techniques are presented. The results appear to be very attractive when relatively large channel bandwidths are available. An investigation of the performance of some elementary narrowband multipath communication techniques indicates that they may offer competitive performance potentials under some conditions. For many types of multipath channels, the advantages of seeking generally optimum communication techniques are somewhat limited. (Contractor's abstract)

2923

Stanford U. Stanford Electronics Labs., Calif.

NATURAL FREQUENCIES OF TUNNEL DIODES WITH PARASITICS, by B. S. Golosman and R. W. Newcomb. May 1962, 18p. incl. diagrs. (Technical rept. no. 2250-2; rept. no. SEL-62-060) (AFOSR-3908) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) Unclassified

The regions of allowed natural frequencies in Re $p \geq 0$ are determined for 2 different circuits which correspond to linearized equivalent circuits for tunnel diodes. Passive networks to obtain any possible natural frequency are given. Multiple-diode circuits are treated, and for identical diodes it is shown that the best results occur with 2 diodes. (Contractor's abstract)

2924

Stanford U. Stanford Electronics Labs., Calif.

AN INVARIANT INPUT FOR A PATTERN RECOGNITION MACHINE, by G. H. Ball. Apr. 1962, 132p. incl. diagrs. tables, refs. (Technical rept. no. 2003-4; rept. no. SEL-62-051) (AFOSR-4161) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 288807 Unclassified

Information extracted from a visual pattern by the receptor is required to be invariant with respect to the rotation and the translation (and at times, scale changes) of the pattern. Numerical parameters are obtained from the pattern that correspond to the shape of the pattern. Integral geometry is employed to obtain these invariant parameters. Probabilities of misclassification are found as a function of the number of pattern measurements that are used to estimate a parameter. The numerical values of some parameters are obtained for the set of patterns consisting of circles, squares, rectangles ellipses, and right isosceles triangles. Decision theory is used to obtain the structure of the test having minimum probability of error (under certain constraints). Majority voting is discussed as a means of combining the results of many tests on a pattern, and 2 electronic devices, which may be useful in the actual implementation of the procedure given, are exhibited.

2925

Stanford U. Stanford Electronics Labs., Calif.

NONLINEAR DISTORTION IN FREQUENCY-DEPENDENT TWO-PORT SYSTEMS WITH APPLICATION TO COMMON-EMITTER TRANSISTOR AMPLIFIERS, by L. N. Ma. Oct. 1962, 66p. incl. diagrs. (Technical rept. no. 1611-1; rept. no. SEL-62-093) (AFOSR-5036) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 293836 Unclassified

For a class of frequency-dependent 2-port systems, departure from linear behavior can be obtained by representing the terminal current at each port by a Taylor series of 4 variables, viz, 2 terminal voltages and their first time derivatives. From this representation, a linear model for the solution of harmonic distortions in a 2-port system can be constructed to consist of a set of harmonic current generators at each terminal in addition to the linear small-signal model. Such a model using harmonic current generators is valid for 2-port systems which depart only slightly from linear behavior, and is suitable for use with general linear termination. Using this model, the solution for harmonic distortion is reduced to the solution of a sequence of linear equations. As an application of the analysis, the nonlinear distortion of alloy junction transistor amplifiers at low current levels is determined. The nonlinearities due to the law of the junction and the space-charge layer widening effect are considered. The nonlinearities of the low-frequency common-emitter short-circuit current gain β_0 and the β cut-off frequency ω_β are also included. The results indicate that the model is valid over an extended range of frequencies and bias conditions. (Contractor's abstract)

2926

Stanford U. Stanford Electronics Labs., Calif.

A STUDY OF MATCHING CONDITIONS IN A TWO-LOOP FREQUENCY MULTIPLIER USING A CAPACITANCE DIODE, by A. Guissard. Dec. 1962, 68p. incl. illus. diagrs. tables, refs. (Technical rept. no. 2256-1; rept. no. SEL-62-154) (AFOSR-64-0626) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) Unclassified

This report is concerned with the problem of finding the matching conditions in a 2-loop frequency multiplier, using a nonlinear capacitance diode. Several authors give theoretical expressions of the efficiency, assuming in most cases that the filters in each loop are tuned, but they do not seem to consider the question of impedance matching in such circuits. This first part of the work is devoted to a theoretical approach to the problem, showing that impedance matching has a meaning for a 2-loop frequency multiplier containing a nonlinear reactance in the common branch. An effort to find out what conditions have to be fulfilled in order to get matching is also included. The analysis is then restricted to the case where the nonlinear reactance is a nonlinear capacitance diode whose characteristic function can be expanded in a Taylor series. The circuit equations for a multiplication of order n are established and the matching conditions are found and discussed. The influence of the dc bias voltage of the diode is also pointed out. (Contractor's abstract)

2927

Stanford U. Stanford Electronics Labs., Calif.

THE ADAPTIVE BINARY-DETECTION PROBLEM ON THE REAL LINE, by R. F. Daly. Feb. 1962 [20]p. incl. refs. (Technical rept. no. 2003-3; rept. no. SEL-62-030) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 273985 Unclassified

The adaptive nature of the binary detector is implied by the expression for Λ (Xk + 1). The previous observations Xk are used in the determination of a probability law for the unknown signal. This probability law is then used to average the likelihood ratio Λ (Xk + 1 s), which is a function of the current observation Xk + 1. (Contractor's abstract)

2928

Stanford U. Stanford Electronics Labs., Calif.

APPROXIMATE SOLUTION IN A FINITE TIME INTERVAL FOR ORDINARY NONLINEAR DIFFERENTIAL EQUATIONS, by R. E. Lindsay. July 1962, 88p. incl. diagrs. refs. (Technical rept. no. 2055-1; rept. no. SEL-62-089) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441212 Unclassified

The object of this investigation is to obtain approximate solutions over finite time intervals to ordinary, nonlinear, differential equations. A new method of approximation is introduced which, for a given differential equation and associated initial conditions, yields an approximate solution which is close to the exact solution everywhere in the prescribed time interval. Because of the nature of the approximate solution, an estimate of the solution error can be obtained from the original differential equation. This approximation technique is compared with some well-known method of approximation. Examples are considered in which the approximation method developed in this research gives superior numerical results. Further, problem areas are indicated (multiple-degree-of-freedom systems, time-variable systems) which are not suitable for treatment by some of the well-known methods but capable of analysis by the technique to be presented in this study. (Contractor's abstract)

2929

Stanford U. Stanford Electronics Labs., Calif.

BANDWIDTH AND SPECTRA OF PHASE- AND

FREQUENCY-MODULATED WAVES, by N. Abramson. Oct. 1962, 21p. (Technical rept. no. 2005-3; rept. no. SEL-62-138) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441214
Unclassified

The spectrum of a cosine angle-modulated by a Gaussian random process (GRP) of (almost) arbitrary spectrum is investigated. Such a GRP provides a convenient model for voice signals, TV signals, and other types of complex communication signals. A simple closed form expression for the bandwidth of the modulated signal in terms of the bandwidth of the modulating signal is found. A general expansion for the shape of the spectrum of the modulated cosine is derived. In addition to reducing, in certain limiting situations, to known results, this expansion provides a practical means of obtaining the spectrum in intermediate cases. Examples are presented showing the spectrum of a cosine modulated by both a lowpass GRP with rectangular spectrum, and a bandpass GRP of Gaussian spectrum. (Contractor's abstract)

2930

Stanford U. Stanford Electronics Labs., Calif.

COMMUNICATION IN RANDOM OR UNKNOWN CHANNELS, by C. E. Rushforth. July 1962, 62p. incl. diagrs. refs. (Technical rept. no. 2004-6; rept. no. SEL-62-086) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 283083
Unclassified

The problem of communicating in the presence of random or unknown multiplicative disturbances is dealt with. The main contributions are in the areas of signal selection and the design and evaluation of the associated receiver. It is shown that the optimum signals for a known channel can be the worst possible signals for the unknown or random channel. Physical reasoning leads us to choose the signals (s' s') and (s', -s'), the first is associated with channel measurement, the second with the transmission of information. The optimum receiver for this set of signals when the channel output is white noise is shown to cross-correlate the perturbed reference with the perturbed message. Evaluation of the error probability for the transmitted-reference system for various situations indicates that, for a fixed signal-to noise ratio, the error probability increases as the time-bandwidth product increases. (Contractor's abstract)

2931

Stanford U. Stanford Electronics Labs., Calif.

COMMUNICATION PROCESSES IN RANDOM MULTIPATH CHANNELS, by C. E. Rushforth. Apr. 1962 [37]p. incl. diagrs. refs. (Technical rept. no. 2004-5; rept. no. SEL-62-063) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 276688
Unclassified

Some of the problems associated with communications through channels whose exact nature is not known, a priori are considered. Two criteria for evaluating system performance are discussed: the probability of error and the divergence between statistical hypotheses. For a particular case of random multipath channel communication, an expression is obtained for the probability of error as a monotonically decreasing function of the divergence. This expression is shown to be identical to an expression obtained for the case of receiving known signals in the presence of additive noise. The adaptive behavior of a receiver is considered with memory making a sequence of observations. It is shown for a particular case that the optimum receiver evolves from one using estimates of the channel output to the classical matched filter or correlation detector using a known channel output. (Contractor's abstract)

2932

Stanford U. [Stanford Electronics Labs.] Calif.

COUPLING OF MODES BETWEEN A SLOW-WAVE PLASMA MODE AND A HELIX, by S. F. Paik. [1962] [6]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and [Signal Corps] under [Nonr-22524])
Unclassified

Published in Jour. Appl. Phys., v. 33: 2468-2473, Aug. 1962.

Propagation of waves in a transmission system consisting of a plasma column and a coaxial helix is investigated. The propagating characteristics of the structure are analyzed by a straightforward field analysis. It is demonstrated that the field solution can be reduced to a simple circuit equation describing 2 coupled tuned circuits. This analytical result shows that the propagation of waves in the plasma-helix structure can be described by a purely capacitive coupling of modes between the space-charge modes of plasma column and the helix mode. The result of this study is compared with earlier work by Bulgakov et al. The limitation of the perturbation techniques is discussed and the condition for the validity of the small perturbation assumption is given. The experimental method of separating and measuring the 2 coupled modes of propagation by means of mode-selecting techniques is described. (Contractor's abstract)

2933

Stanford U. Stanford Electronics Labs., Calif.

A FOUNDATION FOR THE ANALYSIS OF ANALOG-ORIENTED COMBINED COMPUTER SYSTEMS, by D. J. Nelson. Apr. 1962, 171p. incl. diagrs. tables, refs. (Technical rept. no. 1002-1; rept. no. SEL-62-069) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 278507 Unclassified

The theory of errors in analog-type systems is treated, both conceptually and mathematically. The error concepts presented have their roots in matrix theory.

In general, discussion is broken into 2 parts: true error and sensitivity to perturbations. The errors considered are those concerning the solution as a function of time and those concerning the location of the characteristic roots of the piecewise linear system. To properly evolve the concepts, linear systems are considered first with perturbations in parameters and initial conditions. The concepts thus developed are expanded to include nonlinear systems. One chapter is devoted to the mechanics and analysis of deterministic errors in digital differential analyzers (DDA's). The result of this analysis is to resolve the error theory of DDA's to a point equivalent to that of standard analog systems. (Contractor's abstract)

2934

Stanford U. Stanford Electronics Labs., Calif.

HILBERT TRANSFORMS. DISTRIBUTIONAL THEORY, by R. W. Newcomb. Feb. 1962 [15]p. incl. refs. (Technical rept. no. 2250-1; rept. no. SEL-62-029) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 273278 Unclassified

The theory of Hilbert transforms of distributions is presented as a justification for calculations made by engineers. The use of distributional Fourier transforms in evaluating Hilbert transforms is illustrated. (Contractor's abstract)

2935

Stanford U. Stanford Electronics Labs., Calif.

LEARNING TO RECOGNIZE PATTERNS IN A RANDOM ENVIRONMENT, by N. Abramson and D. Braverman. May 1962 [16]p. incl. diagrs. refs. (Technical rept. no. 2003-5; rept. no. SEL-62-071) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 402104 Unclassified

Also published in I. R. E. Trans. on Information Theory, v. IT-8: S8-63, Jan. 1962.

The optimal use of a sequence of prior observations in order to recognize patterns is treated. The class of pattern recognition problems is completely general in that the results may be applied to patterns of a visual, aural or electromagnetic origin. The use of prior observations for pattern recognition may be described as a process of learning the statistical characteristics of the patterns involved. The matnematical description of the learning process is analyzed in order to obtain optimum (i. e., minimum probability of error) solutions to various types of pattern recognition problems. These solutions to the mathematical problem are then interpreted in terms of the systems implementation they imply. The optimum systems are shown to consist of banks of generalized correlators. Under assumption of independent measurements, the optimum systems reduce to a class of systems which function by reinforcing desired responses. (Contractor's abstract)

2936

Stanford U. Stanford Electronics Labs., Calif.

LINEAR ESTIMATION OF SAMPLED STOCHASTIC PROCESSES WITH RANDOM PARAMETERS, by H. E. Rauch. Apr. 1962, 89p. incl. diagrs. tables, refs. (Technical rept. no. 2108-1; rept. no. SEL-62-058) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441527 Unclassified

The general solution is derived for the problem of the optimum linear estimation of a sampled stochastic process, when the transition and output matrices of the model of the process are random parameters that are independent from 1 sample point to the next with known mean and covariance. The resulting estimate is optimum in the sense that it minimizes the trace of the covariance matrix of the error (a generalized mean-squared-error criterion). All of these results are derived from the sampled version of the Wiener-Hopf equation, and they apply without modification to stationary and nonstationary statistics and to growing-memory and infinite-memory filters. (Contractor's abstract)

2937

Stanford U. Stanford Electronics Labs., Calif.

MEASUREMENTS OF AROUND-THE-WORLD HIGH-FREQUENCY PROPAGATION, by R. B. Fenwick. Jan. 1962, 33p. incl. illus. diagrs. refs. (Technical rept. no. 1004-1; rept. no. SEL-62-011) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) Unclassified

During the period April through October 1961, systematic studies of round-the-world (RTW) signals, with transmitter and receiver at the same location, were made at Stanford, California, using 50-kw, 1-msec pulse transmissions in the 12- to 28-mc range. Information obtained includes average monthly curves of RTW maximum frequency vs time of day, time delay and pulse dispersion as a function of radio frequency, variation of optimum propagation azimuth with time of day, and the degree of degradation of RTW propagation by geomagnetic storms. Predicted curves of average monthly RTW maximum propagating frequency vs time of day were obtained with the aid of National Bureau of Standards world maps, and compared with the measurements. These curves adequately predict certain features of RTW propagation, but provide too low an estimate of the maximum frequency that can propagate at any given time, if ionospheric tilts are neglected. The dominant propagating mode is concluded to be a combination of earth-ionosphere-earth hops on parts of the path, and F2-layer - to - F2-layer hops, made possible by layer tilts, on the remainder of the path. (Contractor's abstract)

2938

Stanford U. Stanford Electronics Labs., Calif.

ON APPLIED DECISION THEORY, by N. Abramson and J. Farison. Sept. 1962, 82p. (Technical rept. no. 2005-2; rept. no. SEL-62-095) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441210 Unclassified

This report is based on material from a Stanford University course (EE 252) on the application of statistical decision theory to signal detection, parameter estimation, and pattern recognition. The report is divided into 9 parts: (1) Filters and Noise; (2) Sample Value Representation; (3) Detection of a Known Signal in Noise; (4) General Dual-Hypothesis Test; (5) Signal Detection with Mismatched Filters; (6) Detection of Signals with Random Parameters; (7) Test of a Finite Number of Hypothesis; (8) Estimation; and (9) Discrete Wiener Filters. Part One provides a general review of classical methods of signal detection and parameter estimation. The rest of the report deals with the application of statistical decision theory to these problems. (Contractor's abstract)

2939

Stanford U. Stanford Electronics Labs., Calif.

ON STATISTICAL COMMUNICATION THEORY, by N. Abramson and J. Farison. Aug. 1962, 76p. (Technical rept. no. 2005-1; rept. no. SEL-62-078) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441207 Unclassified

The report is divided into 5 parts: (1) The Narrow-Band Gaussian Random Process, (2) Measurement Problems, (3) Noise Generation, (4) Modulation by Random Processes, and (5) Wiener Filters and Random Sampling. The results presented in the first 3 parts are not new; the methods used to obtain these results, however, are new. These particular parts are presented because the methods are considered substantially superior to those given elsewhere. Both new methods of treating problems and results are given. In particular, results dealing with the spectra of pulsed communication signals and results of sampling on random processes are not known to be published elsewhere. (Contractor's abstract)

2940

Stanford U. Stanford Electronics Labs., Calif.

PAPERS ON ADAPTIVE SYSTEMS, by B. Widrow and G. F. Franklin. May 1962, 93p. incl. diagrs. tables, refs. (Technical rept. no 2104-2; rept. no. 62-003) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441526 Unclassified

This report is a collection of papers on Adaptive Systems. They represent introduction to new and potentially fruitful avenues of research in adaptive control and adaptive logic systems. (Contractor's abstract)

2941

Stanford U. Stanford Electronics Labs., Calif.

RELIABLE, TRAINABLE NETWORKS FOR COMPUTING AND CONTROL, by B. Widrow and J. B. Angell. [1962] [10]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 1554-2; rept. no. SEL-62-146) (Sponsored jointly by Air Force; Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 405015 Unclassified

Also published in Aerospace Eng., v. 21: 78-123, Sept. 1962.

Electronic networks and systems which can perform their intended functions despite defective components, subassemblies, or interconnections within them provide an interesting possibility. A number of proposed techniques are given for achieving this goal and, a detailed consideration will be given to networks of adaptive, or 'trainable', linear elements called Adalines. Such networks have exhibited great tolerance to internal imperfections, and possess many desirable properties as data-processors which can improve with experience. (Contractor's abstract)

2942

Stanford U. Stanford Electronics Labs., Calif.

STUDY OF LINEAR FEEDBACK SYSTEMS WITH PERIODIC PARAMETERS THROUGH AN EXTENSION OF THE FLOQUET THEORY, by L. Lee. Dec. 1962, 88p. incl. refs. (Technical rept. no. 2551-1; rept. no. SEL-62-117) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441208 Unclassified

The basic properties of multi-variable linear feedback systems with periodically varying parameters are investigated. This class of systems is described by linear differential equations with periodic coefficients in the state space. The classical Floquet theory on linear differential equations with continuous, periodic coefficients has been extended to treat linear differential equations with piece-wise continuous, periodic coefficients. The extended Floquet theory is applied to the stability analysis of modulated feedback control systems with continuous and piece-wise continuous carriers. It is shown that analysis and synthesis of many classes of linear feedback systems may be formulated from a unified point of view by using Volterra integral equations of the second kind.

2943

Stanford U. Stanford Electronics Labs., Calif.

THE THEORETICAL HEIGHTS AND DURATIONS OF ECHOES FROM LARGE METEORS, by L. A. Manning.

[1962] [23]p. incl. diagrs. refs. (Technical rept. no. 1150-1; rept. no. SEL-62-137) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 441211 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 68: 1067-1078, Oct. 1964.

Mathematical theory of the durations of radio echoes from overdense trails is developed. Included is the dependence of the height distribution of ionization on meteor magnitude, velocity, zenith angle, the form of the attachment law, the height dependence of diffusion coefficient, and an adjustable relation between luminous and ionizing efficiency. It is shown that well defined attachment-free and attachment-controlled duration regions exist with different line-density and wavelength dependences. The transition zone is broad, and its location depends strongly on meteor velocity. Normalized duration and line-density parameters are defined in terms of which a single computer-calculated duration vs density relation good for all parameter values is plotted. Bridging formulas approximating the duration relation are derived from asymptotic expressions, and the relation between echoing height and duration or line density is presented. Equations are given relating the exponent of the wavelength to echo duration. (Contractor's abstract)

2944

Stanford U. Stanford Electronics Labs., Calif.

A TWO-DIMENSIONAL STUDY OF HIGH-SPEED, HIGH-CURRENT SWITCHING TRANSISTORS, by E. R. Lewis. Feb. 1962 [110]p. incl. diagrs. tables, refs. (Technical rept. no. 1754-1; rept. no. SEL-62-020) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 274270 Unclassified

A study was made of high-speed, high-current switching transistors, which are used in computing systems. It was known that the operation of transistors at very high current levels is greatly affected by emission crowding. The base current causes a voltage drop along the junction and tends to crowd emission toward the edges of the emitter nearest the external base contact. This effect is included in a fairly complete 2-dimensional dc model of a double-diffused, germanium mesa switching transistor. Having been accredited experimentally, the model was applied to some problems in relating device performance to device geometry. Two interesting results accrue. First, the results show no optimum value of base width - the base should just be as narrow as possible. The second result was a normalized curve from which an optimum value of emitter stripe width may be obtained. Finally, a 2-dimensional switching phenomenon is described. It is shown that emission crowding can be considerably enhanced during the turn-on process. Also described is a multitetrode transistor analogue in which enhanced crowding can be actually observed. (Contractor's abstract)

2945

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

THE EFFECTS OF ELECTRIC FIELDS ON THE FLOW OF LIQUID HELIUM, by W. J. Neidhardt and J. Fajans. May 1962, 135p. incl. diagrs. tables, refs. (Research rept. no. SIT-P65(5/62) (AFOSR-2588) (AF 49(638)-352) AD 608395 Unclassified

An investigation was made of the effect of electric fields on the flow of liquid helium in a narrow channel superleak whose exit was maintained at a pressure far below the vapor pressure of the liquid. Liquid helium evaporation in the channel and the resulting liquid-gas interface caused an electric pressure gradient. It was found that electric fields of magnitude 3×10^6 v/cm did not destroy the superfluidity exhibited in the channel. The effect of the applied electric field was to increase flow above and below λ point. Below the λ point, both the normal and the superfluid flows were increased by the applied field. At very high applied field the flow attained a limiting value which was a function of temperature. (Contractor's abstract, in part)

2946

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

ELECTROHYDRODYNAMICS OF SUPERFLUID HELIUM IN NARROW CHANNELS, by W. J. Neidhardt and J. Fajans. [1962] [33]p. incl. diagrs. refs. (AFOSR-2755) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)352] and National Aeronautics and Space Administration) AD 405798 Unclassified

Also published in Phys. Rev., v. 128: 495-502, Oct. 15, 1962.

The flow of superfluid helium from a liquid reservoir to a vacuum through a 10^{-5} cm channel, which was enhanced tenfold by an electric field of 3×10^6 v/cm when a phase boundary occurred within the channel, was unaffected when the boundary moved past the channel and field. Superfluid flow at subcritical velocity given by $\Gamma - \Gamma_0 = f(T)V^2$, when increased to critical flow under the influence of electrostrictive pressures was given by $\Gamma = [\rho_n/\rho][\eta(T_\lambda)/\eta(T)]K_n + [\rho_s/\rho]K_s$, with Γ and Γ_0 the flow with and without applied electric field, V the applied voltage, T the temperature, ρ_n and ρ_s the normal and superfluid densities, ρ the total density, η the viscosity, and K_n and K_s flows obtained from normalization of data. A coincidence was noted between a maximum at 2.06°K in the relative flow and an already reported maximum at 2.10°K in thermal boundary conduction. Any shift in the λ point induced by a macroscopic field of 1.5×10^6 v/cm was less than 0.02°K, but displacements as great as 0.5°K were induced by use of very fine channels.

2947

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

[THEORETICAL RESEARCH IN THE STATISTICAL MECHANICS OF PHYSICS PROCESSES]. Final rept. June 1, 1958-May 31, 1962, 5p. (Rept. no. SIT-P69(7/62)) (AFOSR-2957) (AF 49(638)352) AD 285877 Unclassified

This research was concerned with experimental aspects of low temperature physics, i.e., focusing of phonons in superfluid helium and electrohydrodynamics of superfluid flow in narrow channels. It was proposed that the characteristic phonon emission spectrum of various crystals be measured and that the relative influence of the 2 helium isotopes on the "black body" phonon spectrum be determined. A cryostat for producing temperatures to 0.4°K and apparatus for focusing and detection of phonons was constructed.

2948

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

INTERACTION BETWEEN PLASMA AND A TWO-DIMENSIONAL MAGNETIC DIPOLE, by W. H. Bostick, H. Byfield and others. [1962] [3]p. incl. illus. diagrs. (AFOSR-J523) (AF 49(638)1051) AD 407664 Unclassified

Also published in Phys. Fluids, v. 5: 1305-1307, Oct. 1962.

An account is presented of the results of a series of experiments on the interaction of a rapidly moving, high conductivity copper plasma and a magnetic dipole field. The formation of a cavity in the plasma streaming around the 2-dimensional dipole field is observed. The shape of this cavity and its physical dimensions are in agreement with the theoretical predictions of Hurley.

2949

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

HALL CURRENTS AND VORTICES IN THE COAXIAL PLASMA ACCELERATOR, by W. H Bostick. [1962] [6]p. incl. diagrs. (AFOSR-64-0280) (Sponsored jointly by [Air Force Cambridge Research Center] Air Force Office of Scientific Research under AF AFOSR-62-225, and [Atomic Energy Commission]) AD 431080 Unclassified

Also published in Phys. Fluids, v. 6: 1598-1603, Nov. 1963.

The fact that the current sheet in a coaxial plasma accelerator is planar with the center conductor negative, and bullet-shaped when the center conductor is positive can be at least partially explained by a combination of Hall currents and plasma vortices, both of which should be expected to occur in such an accelerator. This explanation asserts that the peculiar asymmetrical behavior of this accelerator is a consequence of the fundamental property of ordinary-matter plasma: that electrons are light and positive ions are heavy. The sign of the asymmetry would be changed if antimatter plasma were employed. It is doubtful whether a planar current sheet could be achieved with a positronium plasma. (Contractor's abstract)

2950

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

PLASMA VORTICES (Abstract), by W. H. Bostick. [1962] [1]p. (Sponsored jointly by Air Force Cambridge Research Labs., Air Force Office of Scientific Research under [AF AFOSR-62-225] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 176-177, Feb. 28, 1963.

Plasma vortices are observed to be produced by shear in velocity across a magnetic field. Electric-field measurements in a turbulent plasma in a magnetic field indicate that the turbulence is made up of many vortices. Double-probe measurements of ion density show that the plasma density is high within the vortex, and low outside the vortex. An analysis of the plasma coaxial accelerator shows that vortices are expected to be produced in the accelerated plasma and that Hall currents account for the planar-current sheet when the center conductor is negative. An analysis of the θ pinch indicates that Hall currents in conjunction with shear in acceleration should produce a right-handed vortex ring at one end of the coil and a left-handed one at the other. For example, the right handedness is to be expected in all 3 forms: $\nu_\theta \sim \nu_{poloidal}$, $B_\theta \sim B_{poloidal}$, $\nu_\theta \sim \nu_{translational}$. The plasma remaining within the coil is expected to have an angular momentum opposite the ν_θ of the rings emanating from the ends of the coil.

2951

Stockholm U. [Inst. of Physics] (Sweden).

OPTIMAL K^--p SCATTERING CONDITIONS FOR RESOLVING DALITZ' (a+) AND (a-) SOLUTIONS, by M. Roos. [1961] [9]p. incl. diagrs. (AF 61(052)47) Unclassified

Published in Nuovo Cimento, Series X, v. 24: 657-665, May 16, 1962.

It is shown that Dalitz' (a+) and (a-) solutions can be resolved by an elastic K^--p scattering experiment, performed in an optimal way. If the lowest measurable K^--meson laboratory momentum is 53 mev/c and the shortest measurable recoil proton track length is 5 μm, the optimum conditions are met when only events with a K^- scattering angle of 30° or less but with momenta up to the limit of pure s-wave scattering angle are counted. (Contractor's abstract)

2952

Stockholm U. [Inst. of Physics] (Sweden).

THEORETICAL STUDIES IN ANTINUCLEON ANNIHILATION STRUCTURES, by H. Pilkuhn. [1962] [13]p. incl. diagrs. tables, refs. (AF 61(052)47) Unclassified

Published in Arkiv Fysik, v. 23: 259-271, 1963.

The newly discovered ω and φ pion resonances are included in the statistical treatment of antinucleon annihilation. General relations between angular asymmetries of charged annihilation mesons are derived. The magnitudes of these asymmetries are calculated by a modified statistical theory. (Contractor's abstract)

2953

Stockholm U. Inst. of Physics (Sweden).

ANNIHILATION OF 1.3 GEV ANTIPROTONS IN COMPLEX NUCLEI, by B. E. Ronne, P. J. Carlson, and O. Danielsson. [1962] [25]p. incl. diagrs. tables, refs. (AFOSR-3128) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-62-15] and Swedish Atomic Research Council) Unclassified

Also published in Arkiv Fysik, v. 22: 193-217, 1962.

An investigation of 537 interaction stars in nuclear emulsions, of which 215^{+65}_{-35} are due to 2 gev/c antiprotons and the rest to negative pions, is reported. The antiproton mean free path of annihilation is found to be 26 ± 5 cm. Experimental results concerning antiproton stars are obtained from measurements on the available sample of stars by subtracting the known pion contribution from the measured quantities. The average number of charged pions outside the nucleus for antiproton stars is $2.64^{+0.25}_{-0.32}$ and the average total energy per pion 430 ± 50 mev. The mean number of emitted protons is 7.55 ± 0.70 and the mean energy per star that these carry away is 415 ± 50 mev. The average pion multiplicity in the annihilation process is found to be $5.0^{+0.5}_{-0.6}$.

In carrying out the calculation of this value, detailed study of secondary interactions of primary pions in the nucleus where the annihilation occurred was necessary. It was found that 30% of the primary pions leave the nucleus without interaction, 28% are absorbed, 30% leave the nucleus after one or more elastic and/or charge-exchange scatterings, and 12% give rise to production of new pions through inelastic scattering. No antisigma hyperons were definitely established in spite of a careful search for such particles. (Contractor's abstract)

2954

Stockholm U. Inst. of Physics (Sweden).

INTERACTION OF 2 GEV NEGATIVE π-MESONS WITH EMULSION NUCLEI, by B. E. Ronne and O. Danielsson, [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-3129) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-62-15] and Swedish Atomic Research Council) AD 613754 Unclassified

Also published in Arkiv Fysik, v. 22: 175-191, 1962.

An investigation of 281 interactions of 2 gev/c negative pions with emulsion nuclei is reported. The fraction of stars with charged secondary pions is $75 \pm 3\%$ and the mean number per star of emitted charged pions is 1.21 ± 0.08. Only 2 K-mesons have been observed, which confirms other results that the production cross section of strange particles is low. Results have been compared with the predictions from a cascade calculation by Metropolis et al which starts from the known elementary pion-nucleon and nucleon-nucleon cross sections. The agreement between their calculated data and the experimental results of this study is good as far as the multiplicity, energy spectrum and angular distribution of emitted pions and also the energy spectrum of knock-on protons are concerned. (Contractor's abstract)

2955

Stockholm U. Inst. of Physics (Sweden).

HIGH ENERGY PHYSICS PROPERTIES OF ANTIPROTONS, K MESONS, HYPERONS AND PIONS, by A. G. Ekspong. Oct. 31, 1962, 24p. incl. diagrs. (AFOSR-4737) (AF EOAR-62-15) AD 407166 Unclassified

In an investigation of 537 interaction stars in nuclear emulsion exposed to a beam of 2000 mev/c antiproton mixed with pions and muons, about 215 stars were estimated as being due to antiprotons, and the rest due to pions. Detailed calculations of pion interactions inside the nucleus were performed. No antisigma hyperon was found. (Contractor's abstract, modified)

2956

Stockholm U. Inst. of Physics (Sweden).

PRODUCTION OF Σ HYPERON PION PAIRS, by Å. Frisk and A. G. Ekspong. [1962] [4]p. incl. diagrs. refs. (AFOSR-4413) (AF EOAR-63-11) AD 295949 Unclassified

Also published in Phys. Ltrs., v. 3: 27-30, Nov. 15, 1962.

In order to detect effects due to the Y^* particles, experiments have recently been made in which negative K mesons were arrested in photographic emulsions. When the experiment was begun only Y^*_0 and Y^*_1 were known with masses near 1405 mev and 1385 mev respectively. The results appear to indicate the existence of a Y^*

particle with a mass of 1405 mev but with a width at least 2 orders of magnitude less than the values previously reported, viz $\lesssim 1$ mev.

2957

Stockholm U. [Psychological Lab.] (Sweden).

A COMPARISON OF THE METHOD OF RATIO ESTIMATION AND THE METHOD OF MAGNITUDE ESTIMATION, by M. Mashhour. Jan. 30, 1962, 14p. incl. diagrs. tables, refs. (Technical scientific note no. 8) (AFOSR-2744) (AF 61(052)300) AD 281220 Unclassified

The main features of both methods are briefly reviewed. A modified method of ratio estimation in which the subject is left free to report his impressions in terms of arbitrary pairs of numbers is discussed. The results of a series of experiments on velocity perception with ratio and magnitude estimation are compared, and some of the advantages and disadvantages of both methods are enumerated. It is indicated that the method of magnitude estimation is a special case of the method of ratio estimation, although they can, under special experimental conditions, be equivalent. (Contractor's abstract).

2958

Stockholm U. [Psychological Lab.] (Sweden).

A SUBJECTIVE SCALE AND THE THRESHOLD OF VELOCITY, by M. Mashhour. Jan. 30, 1962, 10p. incl. diagrs. tables. (Technical scientific note no. 9) (AFOSR-2830) (AF 61(052)300) AD 281249 Unclassified

By the method of ratio production, a subjective scale of velocity is established. The psychophysical relation of velocity can be described by a power function which is slightly positively accelerated. Under the same experimental conditions but with a different group of subjects the absolute limen of velocity is determined as 1.57 min of visual angle per sec. It is argued on the basis of the experimental findings that the "threshold" constant found, usually by curve-fitting procedures, is either a sign of a shift in the function or a result of the sampling fluctuation of the observed line around the true regression line. (Contractor's abstract)

2959

Stockholm U. Psychological Lab. (Sweden).

ON FITTING SOME CURVILINEAR FUNCTIONS TO EXPERIMENTAL DATA, by M. Mashhour. Sept. 30, 1962, 19p. incl. diagrs. tables. (AFOSR-4593) (AF EOAR-62-76) AD 401181 Unclassified

The general model of power functions where both the independent and the dependent variables, and 2 special cases in which 1 of the variables involves additive constants, are discussed. Two methods of evaluating the unknown constants concerning each case are developed. These methods are applied to empirical data obtained by experiment on the perception of photopic monochromatic light, gustatory intensity, and time (space, and velocity). These procedures may, with modifications, be employed for other curvilinear functions in which both variable functions require logarithmic transformations in the reduction process. (Contractor's abstract)

2960

Strasbourg U. Inst. de Recherches Nucleaires (France).

RESEARCH ON EXCITED LEVELS IN LIGHT NUCLEI USING 1.5 MEV C-W, by S. Gorodetzky. Jan. 31, 1962 [24]p. incl. illus. diagrs. tables, refs. (AFOSR-2531) (AF 61(052)478) AD 274759 Unclassified

The double γ emission was studied in the monopole transitions of energy 6.06 mev in ^{16}O, 3.35 mev in ^{40}Ca and 1.73 mev in ^{90}Zr, obtained from the reactions $^{19}F(p\alpha)^{16}O$ and $^{40}Ca(pp')^{40}Ca$, and by β^- radioactivity of a ^{90}Sr source, respectively. In the case of ^{16}O, the value $\frac{T_{\gamma\gamma}}{T_{tot}} = (2.5 \pm 1.1) \times 10^{-3}$ is found. For ^{40}Ca and ^{90}Zr upper limits of 2.4×10^{-3} and $1/4 \times 10^{-3}$ respectively were obtained. Comparisons with theoretical predictions and other experimental values are given.

2961

Strasbourg U. Inst. de Recherches Nucleaires (France).

[ELECTROMAGNETIC TRANSITIONS FROM THE 8.88 MEV TO 6.06 LEVELS OF OXYGEN 16] Transitions electromagnetiques 8.88 mev - 6.06 mev dans ^{16}O, by S. Gorodetzky, P. Mennrath and others. [1962] [1]p. incl. diagr. (AFOSR-3106) (AF 61(052)598) Unclassified

Also published in Phys. Ltrs., v. 2: 43, Aug. 1962.

The branching ratio for the decay of the 8.88-mev level to the 6.06-mev level as compared with the direct decay to the ground state is measured as R(8.88 mev - 6.06 mev/8.88 mev - 0 mev) = $(1.20 \pm 0.36) \times 10^{-2}$ The 8.88 mev - 6.06 mev - 0 mev cascade is detected by triple coincidence counting of 2.82 - mev gamma ray to the 6.06-mev level, along with the electron pair produced by the 6.06-mev monopole transition to the ground state.

2962

Strasbourg U. Inst. de Recherches Nucleaires (France).

[ELECTROMAGNETIC TRANSITIONS OF O^{16} BETWEEN 6.92 MEV - 6.06 MEV AND 7.12 MEV - 6.06 MEV] Transitions electromagnetiques 6.92 mev - 6.06 mev et 7.12 mev - 6.06 mev dans O^{16}, by S. Gorodetzky, P. Mennrath and others. [1962] [3]p. incl. diagrs. (AFOSR-3193) (AF 61(052)598) Unclassified

Also published in Phys. Ltrs., v. 1: 14-16, Apr. 1, 1962.

The branching ratio for the gamma decay of the 7.12 - mev level in O^{16} to the level at 6.06 mev and to the ground state is calculated to be R(7.12 mev → 6.06 mev/7.12 mev → 0 mev - 3.5×10^{-5}. It is further found that R(6.92 mev → 6.06 mev/6.92 mev → 0 mev) = $7.1 \pm 2.5 \times 10^{-5}$. The measurements are made by analyzing triple coincidences between the gamma ray of the ground - state transition and the internal electron - positron pairs from $0^+ - 0^+$ decay to the ground state of the 6.06 - mev level.

2963

Strasbourg U. Inst. de Recherches Nucleaires (France).

[MULTIPOLARITY OF THE 2.14 MEV TRANSITION IN $Le^{11}B$] Multipolarite de la transition de 2.14 mev dans $Le^{11}B$, by S. Gorodetzky, F. Scheibling and others. [1962] [2]p. incl. diagrs. (AFOSR-3194) (AF 61(052)-598) Unclassified

Also published in Phys. Ltrs., v. 1: 24-25, Apr. 1, 1962.

Angular correlation of internal conversion pairs from the 2.14 mev transition indicates that its most probable multipolarity is M 1, giving the level a spin 1/2, in agreement with Wilkinson's spin-flip theory.

2964

Strasbourg U. Inst. de Recherches Nucleaires (France).

[ELECTROMAGNETIC TRANSITIONS FROM THE 6.92 MEV TO 6.13 MEV AND 7.12 MEV TO 6.13 MEV LEVELS OF OXYGEN 16] Transitions electromagnetiques 6.92 mev → 6.13 mev et 7.12 mev → 6.13 mev dans ^{16}O, by S. Gorodetzky, P. Mennrath and others. [1962] [2]p. incl. diagrs. (AFOSR-64-1988) (AF 61(052)598) AD 452300 Unclassified

Also published in Phys. Ltrs., v. 1: 116-117, May 15, 1962.

Reactions F^{19} (p,a)O^{16} have large cross sections for the excitation of O^{16} 7.12- and 6.92-mev levels at proton energies of 2030 and 874 kev, respectively. The branching ratio for 0.99 mev-6.13 mev/7.12 mev is estimated to be $(8 \pm 2) \times 10^{-4}$, and that for 0.79 mev-6.13 mev/6.92 to be $(2.5 \pm 1.5) \times 10^{-4}$.

2965

Sydney U. Dept. of Aeronautical Engineering (Australia).

EFFECT OF WAVE INTERACTIONS ON PRESSURE DISTRIBUTIONS IN SUPERSONIC AND HYPERSONIC FLOW, by G. A. Bird. [1962] [6]p. incl. diagrs. tables (AFOSR-J765) (AF AFOSR-61-93) AD 414032 Unclassified

Also published in AIAA Jour., v. 1: 634-639, Mar. 1963.

The pressure distribution over a body of complex shape may be affected by the reflected waves that arise when the wave from a discontinuity in surface slope interacts with the bow shock or expansion wave, the entropy gradient behind a curved bow shock, or the effective area change with distance from the axis in axisymmetric flow. The reflected waves from all these types of interactions are examined by reflection coefficients based on the overall strength of the reflected waves or on the overall change in surface pressure, and also by calculations of the full inviscid flow field by the method of characteristics. (Contractor's abstract)

2966

Sydney U. School of Physics (Australia).

A COMPARISON OF PION AND NUCLEAR INTERACTIONS IN EMULSION AT ENERGIES BETWEEN 10^{11} AND 10^{13} EV, by F. A. Brisbout, C. [F.] Gauld and others. [1962] [2]p. incl. diagrs. (AFOSR-3166) (AF 49(638)842) AD 612975 Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-III: 403-404, Jan. 1962.

From the results obtained by flying a 10 litre stack of emulsion to 126,000 ft over Texas it is shown that: the interaction mean free path of jet secondaries is $37.7^{+3.7}_{-3.2}$ cm, which corresponds to a cross section of about 20 mb/nucleon; the average number of shower particles in secondary jets is 12.3 ± 0.3 and changes (if at all) only slowly with energy; the average number of shower particles in primary jets produced by minimum ionizing particles is 22.5 ± 0.4 and in similar energy intervals is about twice that of the secondary jet; and for secondary jets the average number of heavy prongs decreases with increasing energy.

2967

Sydney U. School of Physics (Australia).

NUCLEAR INTERACTIONS OF THE SECONDARY PARTICLES OF HIGH-ENERGY COSMIC-RAY "JETS", by J. Perrow, C. F. Gauld and others. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-4790) (AF AFOSR-61-92 and AF AFOSR-62-410) AD 623498 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 1238-1245, June 16, 1963.

Fifty-five interactions in the energy range 1 to 100 gev of secondary particles of cosmic-ray jets have been examined. The energy was determined by finding the angle between the secondary and primary direction and assuming a transverse momentum of 0.4 gev/c. The interaction mean free path was 41.7 cm, the average number of shower particles varied from 1.3 to 6.4 and

the average number of black prongs from 5.5 to 8.3 as the energy went from 2.8 to 34.6 gev. The agreement with machine work is good, in contrast to previous experiments where the Castagnoli method of energy estimation and or area scanning was used. The application of the method to energies around 1000 gev is discussed. (Contractor's abstract)

2968

Sydney U. School of Physics (Australia).

THE INTERACTION MEAN FREE PATH OF PROTONS AT 3 TeV, by G. Day, C. F. Gauld and others. [1962] [2]p. incl. table. (AFOSR-J1441) (AF AFOSR-62-410) AD 426556 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 977-978, Feb. 16, 1963.

The mean free path (mfp) of singly charged primary particles in the energy region of 3 tev has been determined using a Bartlett maximum-likelihood technique. With all events taken into account a value of $\lambda p = 22$ cm was obtained. Considering only those events with a potential path greater than 20 cm the mfp became 27 cm. (Contractor's abstract)

2969

Sydney U. School of Physics (Australia).

A NEW METHOD OF RECORDING LARGE COSMIC-RAY AIR SHOWERS, by C. B. A. McCusker and M. M. Winn. [1962] [4]p. (AFOSR-J1442) (AF AFOSR-62-410) AD 426555 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 175-178, Apr. 1, 1963.

The difficulty of recording fast-timing information in a large air-shower array is discussed and a possible solution to this problem is proposed. The time of passage of shower fronts at each detector station in the array is to be measured with respect to the time as given by a time-signal transmitter in or near the array. Details of the method are given. (Contractor's abstract)

2970

Syracuse U. [Dept. of Mathematics] N. Y.

MEROMORPHIC FUNCTIONS WITH VALUES THAT ARE BOTH DEFICIENT AND ASYMPTOTIC, by A. Edrei. [1962] [11]p. (AFOSR-J327) (AF 49(638)571) Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szegö, C. Loewner and others. Stanford, Calif., Stanford U. Press, 1962, p. 93-103.

Let f(z) be a meromorphic function in the z-plane. The paper is concerned with the conjecture of Nevanlinna that every deficient value of f(z) is also an asymptotic value. The author investigates conditions under which the conjecture may hold. To that end, new concepts like B-regular path, opening of a curvilinear sector and lens are used. The conditions turn out in terms of restrictions on the localization of zeros and poles of f(z) on suitable B-regular paths. Then it is shown that all deficient values of f(z), other than 0 and ∞, are necessarily asymptotic values. (Math. Rev. abstract, modified)

2971

Syracuse U. [Dept. of Mathematics] N. Y.

MEROMORPHIC FUNCTIONS WITH VALUES THAT ARE BOTH DEFICIENT AND ASYMPTOTIC, by A. Edrei. [1962] [11]p. (AFOSR-66-0218) (AF 49(638)571) Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szegö, C. Loewner and others. Stanford, Calif., Stanford U. Press, 1962, p. 93-103.

For abstract see item no. 2970, Vol. VI.

2972

Syracuse U. [Dept. of Mathematics] N. Y.

THEORY OF APPROXIMATION, by G. G. Lorentz. Final rept. June 1, 1961-May 31, 1962. June 20, 1962 [3]p. (AFOSR-2896) (AF 49(638)-810) AD 289421 Unclassified

The work completed under this contract considers several aspects of approximation theory. The possibility of uniform approximation of all continuous positive functions f(x) on a compact set A by polynomials with positive coefficients in several given functions $g_1, g_2, \ldots$ is considered. The finer question of the degree of approximation has been solved for the simplest case when A = [0, 1] and there are 2 functions, $g_1 = x$, $g_2 = 1-x$.

Roughly speaking, the error of approximation is the square root of the error obtained by unrestricted polynomials. It has also been shown that the entropy of the set of functions satisfying a Lipschitz condition of order and in addition of uniformly bounded variation, class $\mathrm{Lip}\alpha \cap V$, is $\frac{1}{\epsilon} \log \frac{1}{\epsilon}$. The entropies of sets of functions in the Hausdorff metric are also discussed and it is shown that Kolmogorov's estimates for the classes $\mathrm{Lip}\alpha$ hold not only in the uniform, but also in the L^1-metric. The determination of the widths of the sets $\mathrm{Lip}\alpha \cap V$ are still under consideration. Also under study is the problem of showing that for such classes as $\mathrm{Lip}\alpha$, etc., well approximated by arbitrary linear means can be only a small portion, in the sense of entropy.

2973

Syracuse U. [Dept. of Mathematics] N. Y.

ENTROPIES OF SETS OF FUNCTIONS OF BOUNDED VARIATION, by G. F. Clements. [1962] [11]p. (AFOSR-J1027) (AF 49(638)619) AD 419710 Unclassified

Also published in Canad. Jour. Math., v. 15: 422-432, 1963.

The author, using the results of K-7 is concerned with further calculations of H_ϵ and C_ϵ where the A are sets of functions of f(x) with the additional restriction of bounded variation. Denote $f(\epsilon) < g(\epsilon)$ for $f(\epsilon) = O(g(\epsilon))$ and $f(\epsilon) \approx g(\epsilon)$ if both $f(\epsilon) < g(\epsilon)$ and $g(\epsilon) < f(\epsilon)$. The following is proved: (1) Let V_σ be a set of uniformly bounded functions on [0, 1], satisfying a Lipschitz condition of order σ $(0 < \sigma < 1)$ and with total variation not exceeding some constant $B > 0$; then for $A = V_\sigma$, $H_\epsilon \approx C_\epsilon \approx (1/\epsilon) \log (1/\epsilon)$. (2) Let X_n be a cube in the Euclidean n-space with the usual metric ρ and let X_n^* be the set of all non-void closed subsets of X_n with the Hausdorff metric σ derived from ρ; then $H_\epsilon \approx C_\epsilon \approx (1/\epsilon)^n$ for this X_n^*. The calculation of H_ϵ and C_ϵ for the sets ${}_cX_n^*$, ${}_LX_n^*$ and M_L consisting of certain continuous parametric curves C contained in X_n, where $M_L \subset {}_LX_n^*$ and the curves $C \in {}_LX_n^*$ are of length not exceeding L is also investigated. Finally, H_ϵ and C_ϵ are estimated to be $\approx (1/\epsilon) \log (1/\epsilon)$ for the set Q_B of functions f defined on [0, 1] for which f(x+), f(x-) exist and $|f(x)| \leq B$, and in which the metric $\sigma(f, g)$ is defined by Hausdorff metric σ (G_f, G_g) between the generalized graphs G_f (of f) and G_g (of g). (Math. Rev. abstract, modified)

2974

Syracuse U. Dept. of Physics, N. Y.

DIRECT TEST FOR THE STRONG EQUIVALENCE PRINCIPLE, by T. A. Morgan and A. Peres. [1962] [2]p. (AFOSR-3871) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)461 and National Science Foundation) Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 79-80, July 15, 1962.

Following unpublished work of Dicke, the authors distinguish (a) the weak equivalence principle: in a freely falling, nonrotating laboratory, all free particles move with constant velocities, (b) the strong equivalence principle: all the laws of physics are the same in that laboratory, independent of its position in space and time, inhomogeneities of the gravitational field being neglected. They accept the view that experiments of the Eötvös type support only (a), and that (b) is justified only by indirect arguments. As a direct test of (b) they propose an Eötvös experiment with oriented nuclei.

2975

Syracuse U. [Dept. of Physics] N. Y.

ASYMPTOTIC PROPERTIES OF GRAVITATING SYSTEMS (Abstract), by P. G. Bergmann, L. Robinson, and E. Schücking. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-461], National Science Foundation and Wright Air Development Division) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 32, Jan. 24, 1962.

If the gravitational field of a physical system tends to zero at large spatial distances, the metric is usually said to be "asymptotically flat". A more detailed analysis leads to these results: (a) In the absence of gravitational radiation the affine connection is asymptotically integrable, i.e., one can speak of "the same vector" at spatial infinity in different directions, but it is impossible to cover the far away regions of space-time with a properly meshing Cartesian coordinate grid. (b) In the presence of gravitational radiation the affine connection is not asymptotically integrable; even at spatial infinity an attempt to transfer, e.g., the direction of the time axis from 1 orientation in space to another by parallel transport will lead to a result that depends on the chosen route.

2976

Syracuse U. [Dept. of Physics] N. Y.

PERTURBATION THEORY FOR THE INTERACTING BOSE SYSTEM (Abstract), by A. Miller. [1962] [1]p. [AF 49(638)461] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 530, Nov. 23, 1962.

The Hamiltonian for a Bose system of density n is written $H_0 + H'$, where H_0 provides a field for particle motion without change of momentum, and H' scatters particles from plane-wave states. For sufficiently repulsive forces, the energy spectrum of H_0 contains a gap of magnitude nV_0, where V_k is the Fourier transform of the 2-particle interaction. This gap removes the 3rd-order divergence in the Rayleigh-Schrödinger perturbation series. Expressions for the ground-state energy are obtained in terms of V_k for the 2nd through 4th order. The 2nd-order result reproduces the energy shift found by various authors. For nonzero temperature, the partition function and chemical potential are expanded in a power series in V_k, using H_0 as the Hamiltonian. Similar expansions for the expectation value of the energy and the density-correlation function yield expressions for the specific heat and the excitation spectrum, to 1st order in V_k.

2977

Syracuse U. Dept. of Physics, N. Y.

IMPURITY STATES ASSOCIATED WITH SUBSIDIARY ENERGY-BAND MINIMA, by H. Kaplan. Dec. 1962, 17p. incl. diagr (AFOSR-64-1244) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)642 and National Aeronautics and Space Administration) AD 402925 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 1593-1599, Dec. 1963.

Two results have been established concerning the existence of localized electronic states associated with a point impurity in a substance having a spherical energy band, $E(k) = \epsilon_0 + \epsilon_1 \times \cos k + \epsilon_2 \cos 2K)$, where $k = k$ with a subsidiary minimum at $k = 0$. The 1st result is a generalization of Slater and Koster's result, that in 1 dimension an energy band with a subsidiary minimum has no localized states associated with this minimum if the impurity potential is of the delta-function type; i.e., it has only 1 matrix element between Wannier functions, a diagonal 1 referring to 1 site. This result also holds for a spherical band in 3 dimensions. The 2nd result is that, for the Coulomb-impurity potential screened by the static dielectric constant, and the above spherical band, there are hydrogen-like localized states built out of states near the subsidiary minimum, even when all powers of k in E(k) are taken into account in the equation for the envelope function. The deviation of the impurity potential from slow variation causes a long lifetime for decay of the localized state into conduction states of the same energy. For a typical shallow impurity state, the lifetime is approximately equal to 10^{-8} to 10^{-9} sec. (Contractor's abstract)

2978

Syracuse U. Dept. of Physics, N. Y.

LATTICE VIBRATIONS OF ZINCBLENDE STRUCTURE CRYSTALS, by H. Kaplan and J. J. Sullivan. [1962] [10]p. incl. diagrs. tables, refs. [AF 49(638)642] Unclassified

Published in Phys. Rev., v. 130: 120-129, Apr. 1, 1963.

In this article expressions are presented based on the shell model of lattice dynamics, for all important long-wavelength properties of the lattice vibration spectrum of a zincblende structure crystal, and for the vibration frequencies having wave vectors at the Brillouin zone boundary in the [100] direction. General first and second neighbor short-range force constants are used. The formulas are presented in the distortion dipole form of Mashkevich and Tolpygo, which uses 1 constant, α to describe the electronic polarizability of each atom, rather than the 2 redundant constants Y and k, the shell charge and polarization spring, respectively, used in the shell model. Some of the force constants in the expressions are evaluated for GaAs, InSb, AlSb, and ZnS with the aid of available experimental data. The authors were unable to fit all of the data for any substance with only first neighbor force constants. When small, realistic values of second neighbor constants were used, a multitude of fits resulted. The absence of a criterion determining the "best" fit results in a spread of possible ionic charge values of about 1 electronic charge for the 3-5 compounds, and an inability to decide whether ZnS is very ionic or rather covalent. Results point up the necessity of calculations of atomic force constants from fundamental quantum mechanics.

2979

Syracuse U. Dept. of Physics, N. Y.

FORMULATION OF THE SCATTERING FUNCTIONS IN TERMS OF THE UNITARY REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP, by A. O. Barut. [1962] [3]p. (AFOSR-2073) (In cooperation with California U., Lawrence Radiation Lab., Berkeley) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)801 and Atomic Energy Commission) Unclassified

Also published in Phys. Rev., v. 127: 321-323, July 1, 1962.

A group-theoretical basis of the axiomatic S-matrix theory is presented. The unitarity condition is taken as the scalar product of the scattering functions which then are shown to transform according to the unitary representations of the inhomogeneous Lorentz group. The general transformation property of the invariant scattering functions is given which allows one, in principle, to write down these functions for arbitrary processes. (Contractor's abstract)

2980

[Syracuse U. Dept. of Physics, N. Y.]

VIRTUAL PARTICLES, by A. O. Barut. [1962] [3]p. incl. diagrs. (AFOSR-2074) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)801 and Atomic Energy Commission) Unclassified

Also published in Phys. Rev., v. 126: 1873-1875, June 1, 1962.

Particles or resonances which do not correspond to the usual Breit-Wigner type poles in the partial wave amplitudes are defined. They are described in terms of the trajectory of the poles of the S matrix in the complex angular-momentum plane as a function of energy, when this trajectory does not quite reach a physical value of J. Range and scattering parameters are used to determine the trajectories near the threshold, which in turn are related to high-energy cross sections for processes in which these particles are exchanged in the cross channels. The trajectories for the 2 definitely known examples, namely the I = 0, π-π, S-wave virtual state, and the single n-p S-wave virtual state, as well as the triplet n-p trajectory, are determined. (Contractor's abstract)

2981

Syracuse U. Dept. of Physics, N. Y.

ACTION PRINCIPLE FOR HIGHER ORDER LAGRANGIANS WITH AN INDEFINITE METRIC, by A. O. Barut and G. H. Mullen. Jan. 1962 [30]p. incl. refs. (AFOSR-2318) (AF 49(638)801) Unclassified

Also published in Ann. Phys., v. 20: 203-218, Nov. 1962.

A consistent action principle with an indefinite metric and a Lagrangian of any finite order requires that the Lagrangian be invariant under an operation called metric conjugation. This in turn implies that (1) an observable must commute with the metric operator, (2) the S-matrix must be unitary, and (3) transitions between states of opposite metric parity are forbidden. For higher order Lagrangians the energy is still the 00-component of the energy-momentum tensor $T^{\mu\nu}$. It was necessary to split the derivatives of the field variables into normal and tangential components so that canonical conjugate variables could be defined. (Contractor's abstract)

2982

Syracuse U. Dept. of Physics, N. Y.

QUANTIZATION OF TWO-COMPONENT HIGHER ORDER SPINOR EQUATIONS, by A. O. Barut and G. H. Mullen. Jan. 1962 [36]p. incl. Diagr. refs. (AFOSR-2319) (AF 49(638)801) Unclassified

Also published in Ann. Phys., v. 20: 184-202, Nov. 1962.

A 2-component fermion field is quantized using a Lagrangian formalism containing higher order derivatives of the field variables and an indefinite metric in Hilbert space. A consistent quantization necessitates beside a massive spin one-half field, obeying the Feynmann-Gell-Mann equation, the introduction of a massless spin one-half field, obeying the neutrino equation. Gauge invariant electromagnetic and vector interactions are introduced in a manner which depends on the transformation properties of the field variables. The physical restrictions placed on the S-matrix by the use of an indefinite metric eliminates the massless field from the composite field for electrodynamics and pseudo-vector mesons interactions and implies parity invariance but not for 4-field weak interactions. The results obtained for quantum electrodynamics are equivalent to the usual 4-component theory. (Contractor's abstract)

2983

Syracuse U. Dept. of Physics, N. Y.

A COMMENT ON THE Σ-Λ PARITY AND RESOLUTION BETWEEN THE BOUND STATE MODEL AND THE ISOBAR OF Y^*_1, by S. Iwao. [1962] [3]p. (AFOSR-3826) (AF 49(638)801) Unclassified

Also published in Nuovo Cimento, Series X, v. 23: 784-786, Feb. 16, 1962.

The author points out the importance of Λ-p inelastic scattering for the determination of the Σ-Λ relative parity. Assuming that the observed Y^*_1 is completely due to the π-Λ resonance scattering, the author describes the Λ-p inelastic scattering in terms of the 1 pion exchange model.

2984

Syracuse U Dept. of Physics, N. Y.

K-N SCATTERING IN THE MANDELSTAM REPRESENTATION. I. ANALYTICITY OF THE AMPLITUDE AND THE EFFECT OF BARYON POLE ON $K^- + p \to \Sigma + \pi$ REACTION, by S. Iwao. [1962] [22]p. incl. diagr. tabs, refs. (AFOSR-4404) (AF 49(638)801) AD 295948 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 973-994, Sept. 1, 1962.

Analytic properties of the partial wave amplitude for the $K^- + p \to \Sigma + \pi$ reaction are investigated in the total energy space by making use of the Mandelstam representation. The unitarity condition requires the study of the pion-hyperon as well as the kaon-nucleon scattering The latter interaction will not be important for the long-range part of the interaction, so we neglected the effect of it in this paper. The long-range part of the interaction due to the single-baryon exchange can explain the observed low-energy pion-hyperon resonances. The low-frequency of the Σ-hyperon in the I = 1, p 3/2 resonance is interpreted by an accidental cancellation of the long-range potential, and hence the universality of the strong pion-baryon interaction still holds for the ΣΣπ interaction. The I = 0 and I = 2, p 3/2 resonances can be interpreted by the attractive long-range interaction in the pion-hyperon scattering. (Contractor's abstract)

2985

Syracuse U. Dept. of Physics, N. Y.

DISPERSION RELATIONS AND RESONANCE SCATTERING, by A. O. Barut. [1962] [84]p. incl. diagrs. refs. (AF 49(638)801) Unclassified

Presented at Summer Inst. for Theoretical Physics, Colorado U., Boulder, 1961.

Published in Lectures in Theoretical Physics, ed. by W. E. Brittenm, B. W. Downs, and J. Downs. New York, Interscience Publishers, 1962. v 4: 460-523.

In these lectures, the dynamical approach to quantum theories based on the analytical properties of the S-matrix or the scattering amplitude is studied. The emphasis is placed on the nonrelativistic case, although the relativistic case is also introduced at the end. Special attention is given to the description of resonances and bound states throughout the development. The inductive approach to the subject is followed and then the deductive formulation is discussed at the end.

2986

Syracuse U. Dept. of Physics, N. Y.

A THEORY OF HYPERFRAGMENTS. III. NA - NT EXCHANGE FORCES AND π^+-MESIC DECAY, by S. Iwao. [1962] [11]p. incl. tables. [AF 49(638)801] Unclassified

Published in Nuovo Cimento, Series X, v. 25: 890-900, Aug. 16, 1962.

The redetermination of the N-A interaction parameters is done by making use of the recent experimental information on the A binding energies for p-shell hyperfragments. The comparison of the parameters thus obtained with those by Dalitz and Downs favors the antiparallel spin for the p-shell hyperfragments. The study of the exchange forces gives information on the probability of the Σ^+-bound state. The probability amplitude obtained in this way is compared with the observed π^+-mesic decay probability. (Contractor's abstract)

2987

Syracuse U. [Dept. of Physics] N. Y.

PARAMAGNETIC RELAXATION IN SMALL PARTICLES, by A. Honig. [1962] [4]p. incl. diagr. (AFOSR-64-0414) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)966] and National Science Foundation) AD 435663 Unclassified

Also published in Paramagnetic Resonance; Proc. of the First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), New York, Academic Press, v. 2: 439-442, 1963.

It is known that the lowest phonon mode frequency which can exist in a crystal is given by $\nu = v_s/2L$, where L is the largest dimension of the crystal and v_s is the speed of sound in the crystal. At sufficiently low temperatures, single phonon processes dominate the relaxation, since the temperature dependence of Raman processes is at least T^7 while that of single phonon processes is approx T. For single phonon spin flip processes, it is clear that if $L < h\nu_s/2g\mu_B H$, the relaxation cannot occur. In the case of n-type silicon, taking v_s as approx 10^6 cm/sec yields a cut-off to the single phonon spin-lattice relaxation at 300 gauss for 5 μ particles. Such particles have been prepared and results on silicon are discussed. Donors in silicon are a particularly favorable paramagnetic system since it has already been established that at 1°K, single phonon processes dominate and because the relaxation times are long enough to permit use of field cycling techniques for measuring relaxation at the low magnetic fields. Information can be obtained on phonon coupling of the particles through various media with this type of experiment. (Contractor's abstract)

2988

Syracuse U. Dept. of Physics, N. Y.

MAKING SMALL IRON SPHERES BY MELTING IRON POWDER, by R. Stover and J. W. Trischka. [1962] [1]p. (AFOSR-3404) (AF AFOSR-60-23) AD [illegible] Unclassified

Also published in Rev. Scient. Instr., v. 33: 694, June 1962.

The spheres were made by placing a mixture of 100 mesh Fe powder and powdered Al_2O_3 (ignited powder) in a hole bored in a graphite rod. An induction furnace, through which H_2 gas flowed, was used to obtain the required temperature. Not all, but most spheres were free from surface imperfections, which could be detected with a microscope if they were 0.2% of the diam. Microscope measurement of sphere diam showed no variations within the accuracy of the measurements, about 1%. The above method is, of course, useful only if a small number of spheres of a certain approx size are needed. The spheres which were made had diam mostly in the range from 0.0025 to 0.0045 in.

2989

Syracuse U. Dept. of Physics, N. Y.

CIRCUIT FOR NOISE REDUCTION IN A MAGNETIC SUSPENSION BALANCE, by J. W. Trischka. [1962] [2]p. incl. diagrs. (AFOSR-J130) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-60-23 and Office of Naval Research) AD 400192 Unclassified

Also published in Rev. Scient. Instr., v. 33: 1120-1121, Oct. 1962.

The circuit described here should be of use in any situation in which the output of a servo-amplifier is used to detect a signal, but where difficulty is encountered because of its high noise level relative to an amplifier, which operates with very low power output by comparison with the servo-amplifier.

2990

Syracuse U. Dept. of Physics, N. Y.

CLASSICAL RADIATION RECOIL, by A. Peres. [1962] [5]p. incl. refs. (AFOSR-J162) (AF AFOSR-62-36) AD 400066 Unclassified

Also published in Phys. Rev., v. 128: 2471-2475, Dec. 1, 1962.

The conditions under which a material system may recoil while emitting electromagnetic or gravitational radiation are investigated. The lowest order secular effects in the electromagnetic case arise from an interference of the electric dipole radiation with the electric quadrupole or magnetic dipole radiations. In the gravitational case, the lowest order terms involve the

interference of the mass quadrupole radiation with the mass octopole or the flow quadrupole radiations. The investigation of the gravitational radiation recoil is carried out in complete analogy with the more elementary electromagnetic case, so that this paper should be accessible to physicists having no previous knowledge of general relativity theory.

2991

Syracuse U. Dept of Physics, N. Y.

GRAVITATIONAL NEWS, by T. A. Morgan and A. Peres. [1962] [3]p. incl. refs. (AFOSR-J625) (AF AFOSR-62-36) AD 414142 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 1266-1268, Mar. 1, 1962.

The "news function" of a material system emitting gravitational waves is shown to depend, at large distance from the source, essentially on the second (retarded) time derivatives of the mass quadrupole, $Q^{ab} = \int T^{00} (X^a X^b - 1/3\ \delta^{ab} X^c X_c)\ d^3X$ (T^{00} = gravitational energy), and the total rate of loss of mass by gravitational radiation is given by $m = -1/5\ \ddot{Q}^{ab}\ddot{Q}_{ab}$. Observation of gravitational radiation would therefore provide information about the mass quadrupole components.

2992

Syracuse U. Dept. of Physics, N. Y.

SPURIOUS NATURE OF ULTRAVIOLET DIVERGENCES, by A. Peres. [1962] [12]p. incl. refs. (AFOSR-J744) (AF AFOSR-62-36) AD 413368 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 78-89, Apr. 1, 1963.

It is possible to remove ultraviolet divergences from Feynmann diagrams by first differentiating them with respect to their external momenta, then integrating with respect to the internal momenta, and finally integrating back with respect to the external momenta. The last (indefinite) integrals involve arbitrary integration constants, which have to be fixed by further prescriptions, e.g. by requiring that there should be neither mass nor charge renormalization. The whole procedure is consistent with the requirements of covariance, unitarity, and causality, so that the ultraviolet divergences should be considered as entirely spurious. The results obtained by the present method are identical to those of renormalized quantum field theory, whenever renormalization is possible, but are reached here with less computational labor. The present method displays very clearly the arbitrariness involved at each stage of the perturbation procedure, which is quite parallel to the semi-phenomenological approach of dispersion theory. (Contractor's abstract)

2993

Syracuse U. [Dept. of Physics] N. Y.

GENERALIZATION OF A THEOREM BY GOLDBERG AND SACHS, by I. Robinson and A. Schild. [1962] [6]p. incl. diagr. [AF AFOSR-62-36] Unclassified

Published in Jour. Math. Phys., v. 4: 484-489, Apr. 1963.

A connection is established between algebraic degeneracy of the Weyl tensor, the existence of a null geodesic shear-free congruence, and certain restrictions on the Ricci tensor which are weaker than the gravitational equations for empty space. The result is roughly, with some important qualifications, that any 2 of these conditions imply the third. These restrictions on the metric are shown to be invariant under conformal transformations.

2994

Syracuse U. [Research Inst. Dept. of Physics] N. Y.

DECAY PROPERTIES OF NEGATIVE KAONS (Abstract), by S. Lichtman, W. Becker and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)588], Atomic Energy Commission, National Science Foundation, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 296, Apr. 23, 1962.

Using the helium bubble chamber as detector, a study was made of the decay properties of negative kaons, obtained from a Berkeley beam of momentum 335 mev/c. Employing selection criteria which insured long-decay secondaries without bias, the effective sample contained 422 events. These were identified by means of a kinematic-fit procedure. Correction for bias, misidentification, and contamination were small, amounting to less than 2% of the sample. The correct percent branching fractions are $K_{\mu 2}^-$ (57.0 ± 3.5), $K_{\pi 2}^-$ (25.5 ± 3.5), $K_{3\pi}^0$ and π^0 + lepton (11.8 ± 2.0), K_τ^- (5.7 ± 0.5), where the errors represent systematic as well as statistical uncertainties. These results are in good agreement with the emulsion K^- decay experiments, which are also analyzed by kinematic fitting. On the other hand, the above results for $K_{\mu 2}$, $K_{\pi 2}$ are in 2 standard deviation disagreement with those measured by means of direct observation of π^0 γ-rays (in Xe) recently reported by Roe et al. The lifetime of the K^- is now being measured: a ± 6% result is reported.

2995

Syracuse U. [Research Inst. Dept. of Physics] N. Y.

FURTHER RESULTS ON THE PROTON HELICITY IN A DECAY (Abstract), by L. Gray, E. [M.] Harth and

others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-588], Atomic Energy Commission, National Science Foundation, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 348, Apr. 23, 1962.

A 3-standard-deviation result indicative of a positive helicity for the A-decay proton was reported in Phys. Rev. Ltrs., v. 7: 264-268, Sept. 15, 1961 (see item no. 1242, Vol. V). This study has been continued so as to double the data effectively. These data were obtained in an exposure of the helium bubble chamber to a Berkeley low-energy K^- beam. The A-decay proton polarization was directly measured by means of subsequent proton-helium scattering. Until the time of writing, selection criteria yielded a sample of 169 events with average transverse proton polarization of 80% and an observed average analyzing polarization of ~ 40%. A maximum likelihood analysis gives α_A = -0.67 (+0.36, -0.29) for the A-decay asymmetry parameter. This confirms our previous determination and is in agreement with other recent results. More-extensive results are reported.

2996

Technical Operations, Inc., Burlington, Mass.

DATA-PROCESSING REQUIREMENTS OF VELA UNIFORM, TASKS I, III, IV, by C. G. Fain and B. A. Francis. Final rept. May 15, 1962. 40p. incl. diagrs. table. (Rept. no. TO-B 62-28) (AFOSR-2592) (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under AF 49(638)-1108) AD 284633 Unclassified

This is the final report of a 6-month study of the data-handling and data-processing problems associated with Tasks I, III, and IV of VELA UNIFORM, a program for the design of a world-wide detection system for underground explosions. An earlier report on Task I, the World-Wide Standard Seismological Network, is summarized and specifications are given for a microfilm storage and reproduction system for seismograms. The 4 basic functions of Task III, Systems Development, and Task IV, Nuclear and Chemical Research Explosions, are defined, and the implementation of these functions and the various agencies responsible are discussed. Details are given on the type and form of data being recorded under Tasks III and IV, the daily volume of data expected in fiscal years 1963 and 1964, the data processing to be performed at various locations, and the flow of data to the Data Analysis and Technique Development Center (DATDC). It is recommended that only essential data be kept permanently at the DATDC so that magnetic tapes may be erased and re-used to save storage space and money. The responsibilities of the DATDC and the functions and data-processing facilities required by it are described. A coordination function is suggested to increase the crossflow of information among VELA UNIFORM contractors. The computer programs and programming aids required at the DATDC, together with the digital and analog computer systems selected, are discussed. Maximum use of the FORTRAN programming system is recommended, and an expansion in scope of the present computer program collection and distribution activity at the DATDC is proposed. (Contractor's abstract)

2997

Technical Research Group, Inc., Syosset, N. Y.

TIME DEVELOPMENT OF THE BEAM FROM THE RUBY LASER (Abstract), by R. L. Martin. [1961] [1]p. (AFOSR-66) [AF 49(638)673] Unclassified

Presented at Spring meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 2-4, 1961.

Also published in Jour. Opt. Soc. Amer., v. 51: 477, Apr. 1961.

High-speed streak moving pictures of the beam from the ruby laser are discussed. The pictures were taken with a film speed of about 300 ft sec and a variety of focusing conditions. The relaxation oscillations during the excitation pulse are clearly visible as well as variations in the laser characteristics as a function of time. An analysis of these characteristics are given.

2998

Technical Research Group, Inc., Syosset, N. Y.

CHARACTERISTICS OF THE RUBY LASER (Abstract), by C. Zarowin and R. L. Martin. [1961] [2]p. (AFOSR-67) [AF 49(638)673] Unclassified

Presented at Spring meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 2-4, 1961.

Also published in Jour. Opt. Soc. Amer., v. 51: 476-477, Apr. 1961.

A number of definite cavity modes have been observed in the beam of the ruby laser. Off-axis modes appear to contribute to the observed beam width of 15 min of arc. The analysis of these modes as well as the conditions under which they are observed are discussed. Other operating characteristics of the ruby laser are also given.

2999

Technical Research Group, Inc., Syosset, N. Y.

OPTICAL PUMPING OF CESIUM VAPOR (Abstract), by S. Jacobs, P. Rabinowitz, and G. Gould. [1961] [1]p. (AFOSR-68) [AF 49(638)672] Unclassified

Presented at Spring meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 2-4, 1961.

Also published in Jour. Opt. Soc. Amer., v. 51: 477, Apr. 1961.

The 8^2P states of cesium gas were excited by absorption of 3888-A radiation emitted from a helium discharge lamp. The populations of various states were computed from measured flourescent intensities and compared with the populations expected from the measured lamp intensity. The coherent gain coefficient due to induced emission at 3 μ and 7 μ was found to be sufficient to establish oscillation in a Fabry-Perot-type cavity.

3000

Technical Research Group, Inc., Syosset, N. Y.

FLUORESCENCE OF THE Cr^{+++} PAIR SPECTRUM IN SYNTHETIC RUBY (Abstract), by R. T. Daly. [1961] [1]p. (AFOSR-69) [AF 49(638)673] Unclassified

Presented at Spring meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 2-4, 1961.

Also published in Jour. Opt. Soc. Amer., v. 51: 473, Apr. 1961.

The excitation spectrum of the strong ruby satellite lines at 7008 A and 7040 A have been explored at 77° and 2°K. The low-lying and excited levels of these lines appear to arise from 2 nonequivalent cation pairs in the corundum lattice. A recent determination of these levels

is presented. Results of experiments to produce stimulated emission in a 3-level optical maser using these levels are given.

3001

Technical Research Group, Inc. [Syosset] N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES. by R. Daly, G. Grosof and others. Jan. 19, 1962. 170p. incl. illus. diagrs. tables. (Rept. no. TRG-134-TR-6) (AFOSR-2043) (AF 49(638)673) AD 608954 Unclassified

LASER amplification corresponding to a gain of 6% per meter was measured at 3μ in cesium vapo. optically pumped with light from a helium discharge lamp. Amplification and oscillation at 1 u were measured in a helium-neon system based on collisions of the second kind. The amplification parameters, when optimized resulted in a fain of 9% per meter. Krypton-xenon and zinc vapor are other media utilizing collisions of the second kind which were investigated. Crystals of calcium tungstate containing either Dy(3+) or Nd(3+) were grown. LASER oscillation was observed from 2 crystals of $CaWO_4$:Nd. Direct amplification of the output of a ruby oscillator in a second ruby rod was demonstrated. Three methods of achieving single pulse output from ruby oscillators are described. A pulse of 2,000,000 watts peak power was achieved by one method. A broadband emission was discovered in normally pink ruby (.04% Cr by weight). It accounts for 30% of the total emission, making the quantum efficiency unity. A theoretical analysis of the properties for cube corner interferometers has been experimentally verified. (Contractor's abstract)

3002

Technical Research Group, Inc., Syosset, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES, VOLUME I, ed. by M. C. Newstein and S. A. Rothberg. July 2, 1962 [181]p. incl. illus. diagrs. tables, refs. (Rept. no. TRG-134-TR-7) (AFOSR-2778, v. 1) (AF 49(638)673) AD 278053 Unclassified

Three major analytical tasks were performed. These consisted of the analysis of the modes of a resonator with a pin-hole suppressor, of amplifier performance, and of pulse oscillator performance. A cesium gas LASER, optically pumped by a helium discharge has been made to oscillate at a wavelength of 7.18μ. High gain He-Ne discharge LASERs were constructed and used in the investigation of tunable LASERs and the study of oscillators terminated by prism reflectors. Preliminary experimental verification was obtained for a theory of the normal pulse output from the ruby LASER. A spinning prism Q-switch was used to induce very high peak power pulses from rods of ruby (greater than 10 megawatts) and Nd doped glass (greater than 1 megawatts). The results appear to be within 50% of optimum as predicted by the theory developed under analytical tasks. (Contractor's abstract)

3003

Technical Research Group, Inc., Syosset, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES. VOLUME II. APPENDICES [ed. by M. C. Newstein and S. A. Rothberg]. [July 2, 1962] [169]p. incl. diagrs. tables refs. (Rept. no. TRG-134-TR-7) (AFOSR-2778, v. 2) (AF 49(638)673) AD 420330 Unclassified

Work is reported on the following tasks: (1) Modes of resonator with pin-hole suppressor. (2) Amplifier performance (single pass). (3) Pulse oscillator performance. (4) Enhancement in mercury-krypton and xenon-krypton discharges, (5) Bates-Damgaard calculations of A-Values for some transitions in ZnI, (6) Confocal and nonconfocal resonators at LASER wavelengths, and (7) Ruby output-progress.

3004

Technical Research Group, Inc., Syosset, N. Y.

OPTICAL RANGE FINDER APPLICATION OF THE LASER (Abstract), by L. Goldmuntz. [1961] [1]p. [AF 49(638)673] Unclassified

Published in Proc. Nat'l. Electronics Conf., v. 17, 156, Oct. 1961.

The extraordinary spectral purity and narrow beam width of coherent optical radiation leads to some immediate applications, even with the presently available imperfect realizations of LASER. A range finder which utilizes ruby radiation has been demonstrated by TRG. It displays an accuracy of ± 25 ft to ranges of 15,000 ft. The limitation to the performance of the range finder is LASER back-scatter from atmospheric particles and scattering of ambient light. The system operates on the basis of an automic quasi correlation technique in the receiver. Ranges approximately out to the limits of visibility can be obtained at present. Ranges beyond the limits of visibility within the earth's atmosphere can be obtained by short pulse LASER devices operating in conjunction with optical heterodyne techniques in the optical receiver. This system can be developed by extrapolations from present state of the art techniques.

3005

Technical Research Group, Inc., Syosset, N. Y.

BATES-DAMGAARD CALCULATIONS OF A-VALUES FOR SOME TRANSITIONS IN Zn^1, by S. Winsberg. Apr. 9, 1962 [23]p. incl. diagrs. tables. (Technical note no. 44) (Bound with its AFOSR-2778, v. 2: AD 420330) [AF 49(638)673] Unclassified

The Bates-Damgaard approximation for obtaining spontaneous emission probabilities or A-value is described and then applied to various transitions in Zn^1. A discussion of the general validity of the Bates-Damgaard approximation is presented and an estimation of the reliability of the results is made. (Contractor's abstract)

3006

Technical Research Group, Inc., Syosset, N. Y.

CONFOCAL AND NON-CONFOCAL RESONATORS AT LASER WAVELENGTHS, by G. Grosof and G. Gould. June 12, 1962 [38]p. incl. diagrs. tables. (Technical note no. 45) (Bound with its AFOSR-2778, v. 2; AD 420330) [AF 49(638)673] Unclassified

Since confocal and nonconfocal resonators have the advantages over conventional Fabry-Perot resonators (reduction of diffraction losses reduction of tolerances on optical quality and alignment, choice of using prism retro-reflectors and a greater diffraction loss discrimination), these cavities are especially attractive for the design of gaseous lasers. This experiment, confined to the lowest-loss resonant mode resonant mode called by Boyd-Gordon the TEM_{00q} mode, gives the analytic expressions for 4 types of cavities: confocal sphere-sphere confocal sphere-flat, nonconfocal sphere-sphere and nonconfocal sphere-flat. It is considered important that the diffraction loss for a confocal cavity is usually less than that for a similar Fabry-Perot cavity. A procedure for estimating the maximum tilt angle of confocal and nonconfocal cavities is described. The extremes in dimensions are estimated.

3007

Technical Research Group, Inc. Syosset, N. Y.

CONTINUOUS OPTICALLY PUMPED Cs LASER, by P. Rabinowitz, S. Jacobs, and G. Gould. [1962] [4]p. incl. diagrs. (AF 49(638)673) Unclassified

Published in Appl. Opt., v. 1: 513-516, July 1962.

A continuously operating 7.18-μ laser oscillator has been built using optically pumped cesium vapor as the amplifying medium. A power of 50 μw is coupled out of the confocal resonator by means of a 45° BaF_2 pickoff window. The measured intensity distribution is in good agreement with that derived from the Boyd-Gordon expression for the lowest-order mode. (Contractor's abstract)

3008

Technical Research Group, Inc., Syosset, N. Y.

ENHANCEMENT IN MERCURY-KRYPTON AND XENON-KRYPTON GASEOUS DISCHARGES, by G. Grosof and R. Targ. [1962] [12]p. incl. diagrs. refs. (Bound with its AFOSR-2778, v. 2; AD 420330) [AF 49(638)673] Unclassified

Also published in Appl. Opt., v. 2. 299-302 Mar. 1963

This research, directed toward obtaining population inversion in various gas discharges suitable for use in LASERs, reports on 2 related experiments in which krypton atoms in the $1s_5$ metastable level selectively excite either mercury or xenon energy levels by collisions of the second kind. With krypton added to mercury a coherent gain of 1% in a path 1.6 m. long for light of wavelength 1.7987 μ was achieved. Because of the difficulty of controlling the mercury vapor pressure it may be assumed that the conditions described do not necessarily give the largest attainable gain coefficient. The experiments were performed with natural mercury, a mixture of isotopes, which exhibits a complex spectra. It is advisable to use the readily available mercury-198 isotope. With krypton added to xenon, selective excitation resulted in line enhancement by a factor of 5 over pure xenon.

3009

Technical Research Group, Inc., Syosset, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES, by M. Newstein and S. Rothberg. Quarterly technical summary rept. no. 2, Sept.-Nov. 1962, 1v. incl. diagrs. tables. (Rept. no. TRG-134-QTR-2) (AF 49(638)673) AD 292165 Unclassified

Variation of power output from a gaseous LASER when the frequency is scanned over the Doppler lineshape is reported. A theory of perturbed cavities was applied to the case of small curvature. An analysis was made of the fluctuations in the output of a quantum detector of arbitrary quantum efficiency preceded by a LASER amplifier. Work continued on the development of optically pumped cesium gas LASERs designed to operate in the mw range at 3μ and 7μ. The study of the possibility of utilizing photo-dissociated TlBr as a gaseous LASER medium was pursued. Crystalline and glassy media for rare earth ions were studied. Oscillation was achieved in a LASER cavity consisting of crossed roof prisms. Measurements of flashlamp absolute spectral brightness available stored energy in ruby rod, and output pulse radiant energy were made in order to determine the division of the over-all efficiency of pulse ruby oscillators.

3010

Technical Research Group, Inc., Syosset, N. Y.

RUBY OUTPUT, by B. Hammond and R. Martin. Progress rept. no. 1, May 28, 1962 [14]p. incl. diagrs. table. (Technical note no. 52) (Bound with its AFOSR-2778, v. 2; AD 420330) [AF 49(638)673] Unclassified

This experiment to verify some of the aspects of the output energy vs the input of the ruby laser uses different excitation conditions but constant laser cavity parameters. It is indicated that the output energy E_o should be a linear function of the normalized input energy, $E_i - E_{th}$, with a slope independent of excitation geometry while the slope of the curve $E_o - E_{in}$, should reflect the efficiency of excitation. Results are summarized in graphs. Although considerable variation in the values of the slope C were observed they appear to fall into 2 groups with a substantial gap. This implies different oscillating volumes in the 2 cases. Other evidence for different oscillating volumes comes from measurements of the temperature rise in the ruby. Also photographs of the emitting area of the ruby with focused excitation have

shown peculiar patterns. Two reasons for repeating the experiment with a new multilayer were the large range of the threshold in the V2902 cavity and the fact that the output reflector was partially damaged in an early experiment. The reflectivity of a similar multilayer on a sapphire plate is being measured to try to clear up the observation that the output slope of 0.72 joules/cm^3 is higher than expected for the assumed values of reflectivity and scattering loss.

3011

Technion - Israel Inst. of Tech., Haifa.

RESEARCH ON CROSS STRESSES IN THE FLOW OF DIFFERENT GASES, by M. Reiner. Apr. 1, 1962 [28]p. incl. illus. diagrs. tables, refs. (AFOSR-2974) (AF 61(052)223) AD 278214 Unclassified

Cross-stresses in the flow of different gases: The cross stresses effect as discovered by Reiner in the laminar flow of air is shown to be present in mono-, di- and tri-atomic gases in about the same order of magnitude. Cross-stresses in the laminar flow of gases in accordance with Maxwell's dynamical theory: It is shown that a theorem as established by Maxwell may lead to a cross-stress implying a centripetal effect in torsional flow. (Contractor's abstract)

3012

Technion - Israel Inst. of Tech., Haifa.

THE EULER-LAGRANGE EQUATIONS AND THE CURVILINEAR DERIVATIVE, by Z. Karni. [1962] [6]p. (AFOSR-3192) (AF EOAR-62-57) Unclassified

Also published in Bull. Research Council Israel, v. 11C: 83-88, Apr. 1962.

The connection between the curvilinear derivative of vectors and the Euler-Lagrange equations, in view of which the latter can be obtained without the use of the calculus of variations, is presented and the geometrical significance of these equations stated. (Contractor's abstract)

3013

Technion - Israel Inst. of Tech., Haifa.

TENSORS IN ENGINEERING MECHANICS, by Z. Karni. [1962] [16]p. (AFOSR-3546) (AF EOAR-62-57) Unclassified

Also published in Bull. Research Council Israel, v. 11C: 249-264, Dec. 1962.

A system of tensors is presented which is suitable for the engineer. Tensors remain Cartesian even in curvilinear coordinates and all their components possess the same dimension. A "curvilinear derivative" and a "Christoffel tensor" succeed the covariant derivative and the Christoffel symbols of the ordinary tensor analysis. At the present stage, the analysis is confined to orthogonal coordinates.

3014

Technion - Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

EXPERIMENTAL INVESTIGATIONS OF THE INSTABILITY OF CONICAL SHELLS UNDER EXTERNAL PRESSURE, by J. Singer and A. Eckstein. [1962] [26]p. incl. illus. diagrs. tables, refs. (AFOSR-3396) (AF 61(052)339) Unclassified

Presented at Fourth annual Conf. on Aviation and Astronaut., Feb. 1962.

Also published in Bull. Research Council Israel, v. 11C: 97-122, Apr. 1962.

The results of an experimental program on the instability of thin truncated conical shells under uniform external pressure are presented and discussed. The tests of 71 aluminum alloy conical shells of varying geometries are described, and the results are compared and correlated with other experimental investigations and with theory. The test results verify the theories of Singer and of Seide. The behavior at onset of buckling and the post-buckling behavior is discussed, and the effect of initial out-of-roundness is investigated. (Contractor's abstract)

3015

Technion - Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

BUCKLING OF CONICAL SHELLS UNDER EXTERNAL PRESSURE TORSION AND AXIAL COMPRESSION, by J. Singer, A. Eckstein, and M. Baruch. [Final rept.] Sept. 1962 [66]p. incl. illus. diagrs. tables. (TAE rept. no. 19) (AFOSR-4361) (AF 61(052)339) AD 295047 Unclassified

A method for the analysis of the instability of thin conical shells under external pressure is extended to buckling under torsion and combined torsion and external or internal pressure as well as axisymmetric temperature distributions. The method is based on solution of modified Donnell type stability equations, in the presence of slightly relaxed boundary conditions for the u and v displacements. Two formulations of the solution for torsion and combined loadings are given and compared. For conical shells of small and medium taper ratio, the interaction curves may be approximated by the semi-empirical curve of Grate, Batdorf and Baab (The Effect of Internal Pressure on the Buckling Stress of Thin Walled Circular Cylinders Under Torsion, NACA AAR No. 14E27, May 1944) for cylindrical shells, but for large taper ratio different curves are obtained. Tests of 33 steel, Alclad, and Al alloy conical shells of varying geometries are described. The buckling and post-buckling behavior and the effect of initial out-of-roundness are discussed. The results of another experimental program on the instability of thin truncated conical shells in torsion and under the combined loading of external pressure and torsion are given, and compared with theory. (Contractor's abstract)

3016

Technion - Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

BUCKLING OF ORTHOTROPIC CONICAL SHELLS UNDER EXTERNAL PRESSURE, by J. Singer and R. Fersht-Scher. Sept. 1962 [27]p. incl. diagrs. tables, refs. (Technical note no. 1; TAE rept. no. 22) (AFOSR-3782) (AF EOAR-62-61) AD 387638 Unclassified

Also published in Aerospace Quart., v. 15: 151-168, May 1964.

Donnell type stability equations for thin orthotropic conical shells are presented and solved for external pressure loading. The solution is likewise applied to stiffened conical shells by consideration of equivalent orthotropic shells. Typical cases are computed and compared with corresponding isotropic shells. Correlation with equivalent cylindrical shells yields a simple approximate stability analysis for orthotropic or ring-stiffened conical shells under hydrostatic pressure.

3017

Technion - Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

BUCKLING OF ORTHOTROPIC AND STIFFENED CONICAL SHELLS, by J. Singer. 1962 [17]p. incl. illus. diagr. tables, refs. (AFOSR-4411) (Sponsored jointly by Air Force Office of Scientific Research under AF EOAR-62-61 and National Aeronautics and Space Administration) AD 400981 Unclassified

Also published in Collected Papers on Instability of Shell Structures, NASA technical note no. D-1510, 1962, p. 463-479.

Donnell type stability equations for thin circular orthotropic conical shells are presented and solved for external pressure, axial compression and combined loading. The solution is likewise applied to stiffened conical shells. Correlation with equivalent cylindrical shells yields a simple approximate stability analysis for orthotropic or ring-stiffened conical shells under hydrostatic pressure. The general instability of stiffened conical shells under hydrostatic pressure is also analyzed.

3018

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

INDUCED MAGNETIC ANISOTROPY IN THIN FERROMAGNETIC FILMS INVESTIGATED AT LOW TEMPERATURES, by A. A. Hirsch and N. Friedman. [1962] 8p. incl. illus. diagr. (AFOSR-4591) (AF 61(052)481) AD 401375 Unclassified

Also published in Physica, v. 29: 543-547, May 1963.

A new method of investigation of induced magnetic anisotropy in thin films is given, which is based on the study of the magnetoresistance effect when 2 crossed magnetic fields are applied. The experiments were carried out from liquid air down to liquid helium temperatures on thin evaporated films of pure Ni or pure Fe placed in a rotated cryostat. It was shown that when the films are deposited in an external magnetic field in a vacuum of 10^{-6} mm of Hg, the easy axis of magnetization is induced in the direction of the external field. The experimental data were compared with a theoretical model suggested for the magnetization of films under the influence of 2 crossed magnetic fields. This model was elaborated by means of the approximation of coherent rotation of electron spins in a single domain particle, whose anisotropy was made up of a unidirectional, a uniaxial and a cubic magnetocrystalline component. It was found that films deposited in an external magnetic field show a symmetry around the easy magnetization axis like a spheroidal particle around a polar axis. At very low temperatures the induced anisotropy is more distinct because of vanishing thermal stresses. A process of formation of elongated grains or of chains of small particles seems to be responsible for the induced easy magnetization axis. (Contractor's abstract)

3019

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETIC UNIAXIAL ANISOTROPY IN FILMS AT LIQUID HYDROGEN TEMPERATURES FROM ELECTRIC RESISTIVITY MEASUREMENTS IN CROSSED MAGNETIC FIELDS, by A. A. Hirsch and N. Friedman. [1962] [1]p. (AFOSR-J31) (AF 61(052)481) AD 297275 Unclassified

Also published in Bull. Research Council Israel, v. 10F: 3, Apr. 1962.

Using the crossed magnetic field technique in the study of magnetoresistance effect in thin ferromagnetic wires, this work has been extended to very thin films at liquid hydrogen temperatures. Taking into consideration the dependence of the electric resistivity on the orientation of domain magnetization, conclusions have been drawn about the magnetization process and the magnetic uniaxial anisotropy of the films. These conclusions are based on a theoretical model for the magnetization process in crossed magnetic fields of an elongated particle having a large magnetocrystalline energy.

3020

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

STATISTICAL MODEL APPLIED TO THE REGION OF THE ν_3 FUNDAMENTAL OF CO_2 AT 1200°K, by U. P. Oppenheim and Y. Ben-Aryeh. [1962] [7]p. incl. diagrs. refs. (AFOSR-4772) (AF EOAR-62-120) Unclassified

Under certain conditions the spectral emission (or absorption) of bands of molecules in the gaseous state may be described with the help of the "statistical" model. A new method is developed in order to correlate the observed emissivity of a statistical band with the experimental parameters of the gas (pressure, optical

path, etc.). Use is made of curves of growth for every frequency in the band, and the method is applied to the region of the 4.3-μ bands of CO_2 at a temperature of 1200°K. Experimental results for CO_2 are described, which were obtained by heating the gas in cells of different length in an electrical furnace. Good quantitative agreement is found with experimental results of other workers. It is shown that the statistical model predicts the emissivity correctly over wide ranges of pressure and optical path. (Contractor's abstract)

3021

Technische Hochschule. Inst. fur Stromungsmechanik, Braunschweig (Germany).

AN APPROXIMATE METHOD FOR CALCULATING THE COMPRESSIBLE LAMINAR BOUNDARY LAYER WITH CONTINUOUSLY DISTRIBUTED SUCTION, by W. Pechau. July 2, 1962, 73p. incl. diagrs. refs. (Rept. no. 62/-12a) (AFOSR-3715) (AF EOAR-61-45) AD 285303 Unclassified

An approximate method for calculating the compressible laminar boundary layer with suction was developed. The method is applicable to arbitrary distributions of potential velocity and suction velocity on adiabatic walls at a Prandtl number of unity. With zero pressure gradient, it also holds in the case of heat transfer at constant wall temperature. A comparison with known exact solutions is made, and extensive and systematic computations of the laminar compressible boundary layer with suction on aerfoil sections are performed. In the subsonic range the profile NACA 0010 and in the supersonic range a symmetric biconvex profile with a thickness ratio of 10% is taken at various Mach numbers and angles of incidence. A special study is made on the influence of the location and extent of the suction area on the position of the point of separation. It is shown that a given suction quantity is most efficient in delaying separation when located on the aft part of the profile.

3022

Technische Hochschule, Munich (Germany).

STUDIES ON THE CHANGE OF THE CONCENTRATIONS OF INTERMEDIATES DURING PHOTOSYNTHESIS OF CHLORELLA AND ISOLATED CHLOROPLASTS, by O. Kandler. Final rept. May 1, 1962 [23]p. incl. diagrs. tables, refs. (AFOSR-3406) (AF 61(052)244) AD 283132 Unclassified

The enzymatic determination of the photosynthetic glycollic acid (PGA) concentration in Chlorella did not show a correlation between the rate of photosynthesis and the increase of PGA after darkening. The PGA increase is not prevented by the omission of CO_2, but does not occur under N_2. Hence it is assumed that the change in the PGA concentration depends mainly on the change in the rate of glycolysis by photosynthesis. Presumably glycolysis is controlled by photosynthesis through the competition between light phosphorylation and triose phosphate oxidation for inorganic phosphate. The effects of high KCN concentrations on the distributions of C^{14} and on the concentrations of the intermediates in Chlorella were investigated. A drastic difference between the behavior of the labeled PGA and that of the total amount was revealed by enzymatic analysis. It is assumed, that the very small photosynthesis pool in the chloroplasts exchanges only very slowly with the cytoplasmic pool. In isolated chloroplasts, the pH optimum for CO_2 fixation was determined. In whole chloroplasts it was near 7.3 and near 8.2 in broken chloroplasts. Different amounts of inactive PGA were added to broken chloroplasts to measure the distribution of C^{14} after 15 and 30 min photosynthesis in $C^{14}O_2$. The data did not suggest the occurrence of a favored reduction of the PGA formed newly by CO_2 assimilation, as in Chlorella. (Contractor's abstract)

3023

Technische Hochschule, Munich (Germany).

DIFFERENCES IN THE PH OPTIMUM OF THE PHOTOSYNTHETIC FIXATION OF CARBON DIOXIDE IN ISOLATED WHOLE AND BROKEN CHLOROPLASTS, by H. Elbertzhagen and O. Kandler. [1962] [3]p. incl. diagr. table, refs. (AFOSR-4339) (AF 61(052)244) AD 632020 Unclassified

Also published in Nature, v. 194: 312-313, Apr. 21, 1962.

The fixation of CO_2 in whole chloroplasts is 7.0-7.5 whereas for broken chloroplasts the optimum is 8.0—8.5. The difference in pH optimum is discussed.

3024

Technische Hochschule, Munich (Germany).

[STUDIES ON THE CHANGES IN POOL SIZES OF VARIOUS INTERMEDIATES DURING PHOTOSYNTHESIS UNDER THE INFLUENCE OF DIFFERENT EXTERNAL FACTORS AND INHIBITORS] Suddeutsche versuchts- und forschungsanstalt fur milchwirtschaft weihenstephan, by O. Kandler. Annual summary rept. May 1, 1961, 31p. incl. tables. (AF 61(052)244) AD 632273 Unclassified

The change in concentration of the photosynthetic intermediates in Chlorella were determined with the help of the optical test during the transition from dark to light and vice versa. In addition, the effects of anaerobiosis and CO_2 deprivation were studied. Preliminary calculations showed that the rate of formation of pteroylglutamic acid after turning off the light equals about the rate of CO_2 fixation in the light. The influence of monodoacetic acid, arsenate and dinonyl phthalate photosynthesis of Chlorella was studied in 2 ways. It is assumed that, in Chlorella cells, the path of carbon in photosynthesis proceeds via a pteroylglutamic acid by-pass, where as in broken chloroplasts a reversal of glycolysis, similar to dark fixation takes place. Preliminary experiments in the preparation of whole and broken chloroplasts are described. (Contractor's abstract, modified)

3025

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

NUMERICAL TREATMENT OF THE INITIAL VALUE PROBLEM FOR SYSTEMS OF QUASILINEAR PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER, by R. Albrecht and W. Urich. [1962] [9]p. (AFOSR-4058) (AF EOAR-62-94) AD 450315 Unclassified

Also published in Numerische Math., v. 4: 253-261, 1962.

A description is given for the practical implementation of a method for the approximate solution of the initial value problem for a system of m quasilinear partial differential equations of first order in m dependent and n + 1 independent variables. Only real functions and real variables are considered. The importance of such systems stems from the fact that a properly posed, noncharacteristic initial value problem for an arbitrary system of partial differential equations can be reduced to a problem of the above mentioned type. The method is generalized to the case of quasilinear systems and an error estimate is given.

3026

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

FINITE DIFFERENCE METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS, by R. Sauer. June 15, 1962. 11p. (AFOSR-3190) (AF EOAR-61-21) AD 282452 Unclassified

Two types of finite-difference methods are studied: characteristic finite-difference methods of high accuracy for hyperbolic systems with 2 characteristic directions; and quasi-characteristic finite-difference methods, applicable to a wide class of systems of first order. (Contractor's abstract)

3027

Technische Hochschule] Vienna (Austria).

ELASTIC THERMAL STRESSES IN DELTA WINGS. PART II, by H. Parkus. Dec. 15, 1962 [37]p. incl. diagrs. tables. (AFOSR-4584) (AF 61(052)214) Unclassified

The study of thermal stresses in delta wings is continued. Equations of first approximation for the skew-symmetric temperature part are derived and solved. A numerical example is given. Then the equations of second (and final) approximation are obtained and solved for both the symmetric and the skew-symmetric part. The numerical example is continued into the second approximation.

3028

Technische Hochschule, Vienna (Austria).

CONDUCT THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE AERODYNAMICS OF THE MIXING OF COOLING AIR WITH COMBUSTION PRODUCTS IN A COMBUSTION CHAMBER-INVESTIGATION OF THE DIFFERENCE BETWEEN THE ISOLATED AND UNISOLATED COMBUSTION CHAMBER, by W. Rogner. Final technical rept. Nov. 1, 1961-Jan. 31, 1962. Feb. 28, 1962 [24]p. incl. illus. diagrs. tables. (AFOSR-2667) (AF 61(052)569) AD 275845 Unclassified

Theoretical and experimental investigations were made of the aerodynamics of the mixing of cooling air with combustion products in a combustion chamber. The difference between the isolated and unisolated combustion chamber was determined. The turbulence combustion chamber attained very high degrees of efficiency both in an insulated and noninsulated state and the temperature distribution at the exhaust-end of the combustion chamber was uniform in both cases, particularly so when slight tertiary air quantities were injected against the main flow.

3029

Temple U. [Dept. of Physics] Philadelphia, Pa.

SPECTRAL REFLECTIVITY AS A FUNCTION OF TEMPERATURE OF β-BRASS TYPE ALLOYS, by L. Muldawer. [1962] [9]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)73] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 127: 1551-1559, Sept. 1, 1962.

A number of β-brass alloys undergo reversible color changes as a function of temperature. Normally, yellow β-brass becomes copper-red at about 250°C, the color change taking place gradually. β-AgZn is pink at room temperature and silver gray at 300°C. Similar changes have been observed in β-AgCd, β-AuZn, and β-AuCd. Color changes consistent with the above observations have been noted on cooling to liquid nitrogen temperatures. Although disordering takes place in some of these alloys, it is not thought that these color change phenomena are primarily due to disordering or to surface films. Quantitative measurements of reflectivity as a function of wavelength at several temperatures have been made on β-CuZn, β-AgZn, β-AuZn, β-AgCd, β-AuCd, and α-brass. The reflectivity edge for β-brass shifts from 5000A at 27° to 5300A at 275°C, equivalent to a shift of about -5.6×10^{-4} ev C. Edge shifts of this magnitude were not observed with α-brass, Cu, Au, Au_3Zn, CuAu, and Cu_3Au. A number of possible explanations of the optical results are discussed: it is believed that these results are primarily due to plasma effects strongly influenced by interband transitions. (Contractor's abstract)

3030

Texaco Experiment, Inc., Richmond, Va.

RECOMBINATION OF IONS IN FLAMES, by I. R. King. [1962] [17]p. incl. diagrs. tables, refs. (AFOSR-596) (AF 49(638)650) AD 271360 Unclassified

Presented at the ARS Ions in Flames and Rocket Exhausts Conf., Palm Springs, Calif., Oct. 10-12, 1962.

Also published in Prog. in Astronaut. and Aeronaut., v. 12: 197-214, 1962.

For abstract see item no. 2916, Vol. V.

3031

Texas A. and M. Coll. Dept. of Physics, College Station.

[NUCLEAR MAGNETIC RESONANCE STUDY OF LIQUIDS AND MIXTURES] by M. Eisner. Interim final rept. Apr. 12, 1962, 2p. (AFOSR-2473) (AF 49(638)-934) Unclassified

NMR relaxation studies provide a method for studying the microscopic dynamics of liquids and liquid mixtures. Some success has been achieved in constructing dynamical models which elucidate a variety of experimental observations. The present program was designed to concentrate on the measurement of diffusion coefficients in liquid and to relate these to the intermolecular relaxation processes. The work during this past year was principally concerned with constructing the equipment necessary for measuring diffusion coefficients through nmr spin-echo techniques. The apparatus has now been constructed and tested. Calibration of the equipment against known diffusion coefficients has indicated that the equipment is working satisfactorily. In the theoretical work, it was found that the principal part of the relaxation process could still be characterized by a single relaxation parameter, which is determined largely by pair-interactions. This indicates that the relaxation of complex assemblies can be adequately created by considering the sum of the pair interaction alone. In addition, the small residual part of the relaxation which is characterized by different relaxation parameters seems to be observable.

3032

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

INORGANIC COORDINATION COMPOUNDS: KINETICS AND MECHANISM OF SOME THERMAL REARRANGEMENTS, by W. M. Wendlandt. Final rept. Apr. 4, 1962, 3p. (AFOSR 2492) (AF 49(638)787) AD 454052 Unclassified

The kinetics of the thermal deaquation and rearrangement of the complexes of the type $[Co(NH_3)_5(H_2O)]X_3$, where X was Cl, Br, I and NO_3 was completed, and found to obey a first order rate law. DTA (differential thermal analysis) data showed that the reaction proceeded according to a one step process except in the case of the chloride complex, where an apparent two step process was noted. All of the deaquation peaks occurred in the 100° to 125° C temperature range. Dissociation pressure measurements on the above systems showed that it was irreversible and hence the heat of deaquation, ΔH, could not be determined. However, this value was measured for the chloride and bromide complexes by the method of quantitative DTA. Substituting other trivalent metal cations such as Rh(III) and Ir(III) for Co(III), an attempt was made to study the similar deaquation reactions. These complexes were difficult to prepare in a high state of purity so that the results were questionable. The stoichiometry and possible reaction mechanism for the thermal dissociation of some hexamine type complexes, $[Co(NH_3)_6]X_3$, where X = Cl, Br, NO_3 and SO_4, were determined. Further work is being carried out on a series of pentammine and tetramminecobalt complexes.

3033

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THERMAL DECOMPOSITION OF METAL COMPLEXES. V. SOME HALOPENTAMMINECOBALT (III) HALIDE COMPLEXES, by W. W. Wendlandt and J. P. Smith. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-J1201) (AF 49(638)787) AD 423519 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 25: 843-850, July 1963.

The thermal dissociation of 9 halopentamminecobalt (III) complexes was studied by the techniques of thermogravimetry (in vacuo), differential thermal analysis (in helium) and gas evolution analysis (in helium). The stoichiometry of the dissociation reactions was determined by analysis of the residues and reaction products. Activation energies for the dissociation of several of the complexes were also obtained. The complexes dissociated by 2 different mechanisms: (a) those in which the Co(III) was reduced by iodide ion; and (b) those in which the Co(III) was reduced by ammonia. In the latter case, ammonium halide and nitrogen were also obtained in the reaction products. (Contractor's abstract)

3034

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THERMAL DECOMPOSITION OF METAL COMPLEXES. III. STOICHEIOMETRY OF THE THERMAL DISSOCIATION OF SOME HEXAMMINECOBALT (III) COMPLEXES. by W. W. Wendlandt. [1962] [7]p. incl. diagrs. table, refs. (AFOSR-J1202) (AF 49(638)787) AD 423118 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 25: 545-551, May 1963.

The stoichiometry and probable decomposition sequence for the thermal dissociation of $[Co(NH_3)_6]X_3$, where X is Cl, Br, NO_3, and $[Co(NH_3)_6]_2(SO_4)_3 \cdot 2.5H_2O$, are presented. Differential thermal analysis and gas evolution curves are presented for each of the complexes. The data shows that the reduction of Co(III) → Co(III) is due to ammonia, forming NH_4X(X = Cl, Br or SO_4) and

nitrogen. No free halogen could be detected. Due to the presence of both oxidizing and reducing groups, $[Co(NH_3)_6](NO_3)_3$ decomposed in a different manner than the other 3 compounds. (Contractor's abstract)

3035

Texas Technological Coll. Dept. of Chemistry, Lubbock.

ION RADICALS. THE REACTION OF THIOAROMATIC COMPOUNDS WITH ACIDS. II. DIPHENYL DISULFIDE, THIANTHRENE AND THIANTHRENE OXIDES. by H. J. Shine and L. Piette. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-J236) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-48 and Robert A. Welch Foundation) AD 400875 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 4798-4806, Dec. 20, 1962.

It has not been found possible to recover diphenyl disulfide (I) from solution in 100% sulfuric acid. When 100% sulfuric acid is poured through a bed of I and immediately received onto ice the I is recoverable. In this case the acid solution is pale green rather than purple. Solutions of thianthrene (III), its monoxide V and cis-dioxide VI in 96%, 97%, 100% and fuming sulfuric acid have been investigated. Ultraviolet, visible, near infrared and e. s. r. spectra have been recorded. Products have been isolated quantitatively. Some observations on III in trifluoroacetic acid are made and the work of Fava, Sogo and Calvin is discussed. Solutions of III in 96-97% sulfuric acid are paramagnetic. It is proposed that the species present is the positive ion-radical of diphenylene disulfide. The transformation of V to this species in 96-97% acid is shown in the visible and ultraviolet region and the absorption spectra changes are related to the growth of the spin signal in e. s. r. spectroscopy. The products isolated from III in 96-97% acid are III and V. From III in 100% acid and fuming sulfuric acid the product is mostly V. From solutions of V in 96% acid that have been kept some time the major product is III. It is tentatively proposed that an additional product from these solutions, not yet identified, results from some V behaving as an acceptor during the conversion of V to the ion-radical. Proposals are made to account for the one-electron oxidation of III to the ion-radical. The ion-radical has been detected also in solutions of III in benzene and chloroform to which aluminum chloride was added. (Contractor's abstract)

3036

Texas Technological Coll. Dept. of Chemistry, Lubbock.

ION RADICALS. II. THE ESR SPECTRA OF 2,7-DIMETHYL- AND 2,7-DICHLOROTHIANTHRENE IN CONCENTRATED SULFURIC ACID, by H. J. Shine, C. F. Dais, and R. J. Small [1962] [2]p. incl. diagr. (AFOSR-J285) (AF AFOSR-61-48 and AF AFOSR-63-23) Unclassified

Also published in Jour. Chem. Phys., v. 38: 539-570, Jan. 15, 1963.

The dimethylthianthrene gives rise to a 9-line spectrum. From a consideration of the relative intensities of the lines, it is concluded that electron delocalization occurs in the dimethyl compound similar to that observed in methyl semiquinone ion radicals. 2,7-Dichlorothianthrene produces a 3-line spectrum. This is attributed to coupling of the free electron with the 2 equivalent protons in 3,8-positions.

3037

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. IV. SOME AMINE COMPLEXES OF COPPER(II) SULPHATE, by W. W. Wendlandt. [1962] [10]p. incl. diagrs. table, refs. (AFOSR-J1203) (AF AFOSR-63-23) AD 423042 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 25: 833-842, July 1963.

The thermal dissociation of the mono-, bis-, and tris-(ethylenediamine)-, the bis(1,2-propanediamine)-, and the bis(1,3-propanediamine)-complexes of copper (II) sulphate was studied by thermogravimetry, differential thermal analysis, gas evolution, and high temperature reflectance spectroscopy. The TGA curve obtained for $[Cu(en)_3]SO_4$ corresponded to that expected for the deamination of 1 of the ethylenediamines. The decomposition curves of the bis(amine)-complexes corresponded to a 1 step deamination process, giving $CuSO_4$ which immediately dissociated into CuO and SO_3. The E_a for the deaquation of $[Cu(en)(H_2O)_2]SO_4$ was 29 kcal mol^{-1} as determined by a DTA method. Reflectance curves are given for all of the complexes at ambient temperature as well as $[Cu(en)(H_2O)_2]SO_4$ at elevated temperatures.

3038

Texas Technological Coll. Dept. of Chemistry, Lubbock.

AUTOMATIC DIGITAL RECORDING THERMOBALANCE, by W. W. Wendlandt. [1962] [3]p. incl. diagrs. (AFOSR-J1204) (AF AFOSR-63-23) AD 423043 Unclassified

Also published in Anal. Chem., v. 34: 1726-1728, Dec. 1962.

An automatic recording thermobalance is described which records the voltage variations that are proportional to the weight change of a sample, as it is heated, in an analog (X-Y recorder) as well as digital (digital recorder) form. The system consists of a conventional recording thermobalance in which the voltage outputs from the balance accessory and the furnace thermocouple, after amplification, are converted to a series of pulses. These pulses are counted on an electronic counter and then printed on a digital recorder. Provision is made for printing the furnace temperature voltage, then 5 sec later the sample weight voltage, at intervals of 1 min. The instrument is useful in providing input data for digital computer calculations of thermogravimetric and kinetic quantities of interest. (Contractor's abstract)

3039

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THERMAL DECOMPOSITION OF METAL COMPLEXES. VI. SOME AMMINE COBALT (II) COMPLEXES, by W. W. Wendlandt and J. P. Smith. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-J1486) (AF AFOSR-63-23) AD 427943 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 25: 985-993, July 1963.

The thermal dissociation of a number of cobalt (II) ammine complexes of the type, $[Co(NH_3)_6]X_2$ (X = Cl, Br, I, and NO_3), and $[Co(NH_3)_6]SO_4$, were studied by thermogravimetry, differential thermal analysis, and gas evolution analysis. The thermal dissociation of these complexes involved intermediate ammine complexes containing lower ammonia to cobalt ratios. For the chloride and bromide complexes, the dissociation sequence was: $[Co(NH_3)_6]X_2 - [Co(NH_3)_2]X_2 - [Co(NH_3)]X_2 - CoX_2$. The stoichiometry of the dissociation of $[Co(NH_3)_6](NO_3)_2$ was: $9[Co(NH_3)_6(NO_3)_2 - 3Co_3O_4 + 30NH_3 + 36H_2O + 17N_2 + 4NO + 2N_2O$. (Contractor's abstract)

3040

Texas U. [Dept. of Chemistry] Austin.

ACETYLENE-ETHYLENE OXIDE FLAMES, by R. F. Stubbeman and R. C. Anderson. Feb. 1962 [16]p. incl. diagrs. tables. (Technical note no. 8) (AFOSR-2344) (AF 18(603)142) Unclassified

Ignition and flame propagation limits, flame velocities, and reaction products for flames in acetylene-ethylene oxide mixtures burning in an inert atmosphere have been investigated. Flame temperatures have been calculated. Results bear out the indications noted in earlier tests that ethylene oxide is notably effective in enhancing decomposition of the hydrocarbon. The system does not show promise for practical applications because actual flame speeds and temperatures are rather low. As a flame system, it is of interest because of the pronounced effects apparently of pre-flame reactions, the fact that there are no ignition limits at higher pressures and temperatures, and certain anomalies in composition effects. (Contractor's abstract)

3041

Texas U. [Dept. of Chemistry] Austin.

PREPARATION OF DEUTERATED BUTANES, by M. J. Ijam and L. F. Hatch. Aug. 1962, 14p. incl. diagrs. tables. (Technical note no. 9) (AFOSR-4274) (AF 18-(603)142) Unclassified

The synthesis of terminally-deuterated butanes was investigated. The initial reaction was one of equilibration between deuterium oxide and butandione (diacetyl, $CH_3COCOCH_3$) to obtain deuterated butandione. The extent of deuteration up to 34 equilibrations was determined. Two methods for the reduction of butandione to butane were investigated. The reduction of the dione to the glycol, conversion of the glycol to the dibromide and its reduction to the hydrocarbon was not satisfactory. A 2-step process in which the reaction of the dione with hydrazine in triethylene glycol medium was followed by sodium methoxide reduction of the hydrazone was satisfactory. A quantity of deuterated butane was prepared by this process. Deuterated butane of the type $CH_3CD_2CD_2CH_3$ was prepared by the reaction between butandione and deuterated hydrazine ($ND_2ND_2 \cdot D_2O$) followed by sodium methoxide reduction of the hydrazone. The product was not pure $CH_3CD_2CD_2CH_3$.

3042

Texas U. Dept. of Chemistry, Austin.

EFFECTS OF OXYGEN AND CHLORINE ON THERMAL REACTIONS OF ACETYLENE, by M. S. B. Munson and R. C. Anderson. [1962] [5]p. incl. diagr. tables, refs. (AFOSR-J1460) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)142 and Petroleum Research Fund) AD 426517 Unclassified

Also published in Jour. Phys. Chem., v. 67: 1582-1586, Aug. 1963.

The effects of small percentages of added oxygen or chlorine on the thermal reactions of acetylene in the range of 200-800° have been measured in a flow reactor. The pattern of variation in reaction products was determined chromatographically. Variations with time were studied using a multistage reactor. Oxygen in small amounts increases the rate of decomposition. Chlorine decreases the initial rate, particularly of polymerization, but gives secondary reactions which enhance carbon formation. (Contractor's abstract)

3043

Texas U. Dept. of Chemistry, Austin.

COMPARATIVE STUDIES OF PYROLYSIS OF ACETYLENE, VINYLACETYLENE, AND DIACETYLENE. by K. C. Hou and R. C. Anderson. [1962] [3]p. incl. diagr. tables, refs. (AFOSR-J1461) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)142 and Petroleum Research Fund) AD 426551 Unclassified

Also published in Jour. Phys. Chem., v. 67: 1579-1581, Aug. 1963.

Since vinylacetylene and diacetylene are both straight-chain unsaturated compounds which might be significant intermediates in the pyrolysis of acetylene, a comparative study of the thermal reactions of these 3 compounds was made. Reaction patterns were determined in a flow system, using temperatures in the range of 500-800°, and mixtures of 25 mol % hydrocarbon in helium. Products were analyzed chromatographically. A reactor was also designed to discharge directly into a mass spectrometer, so that tests might be made for free radicals

and the product gases also analyzed in the mass spectrometer. Good results were obtained in detecting methyl radicals formed in reaction of di-t-butyl peroxide and lead tetramethyl, but no evidence was found for any free radical fragments from the acetylenic compounds at temperatures up to 700 . Diacetylene was barely detectable in the low temperature reaction of acetylene, and no evidence was found to indicate it is a likely intermediate in the acetylene reactions under such conditions. Vinylacetylene is readily detected and shows appropriate reactivity, but little tendency to decompose to acetylene. It seems likely that it, like benzene, is a reactive side product rather than a key intermediate. (Contractor's abstract)

3044

Texas U. [Dept. of Physics] Austin.

DISTORTED WAVE CALCULATIONS OF (d, p) ANGULAR DISTRIBUTIONS, by W. R. Smith and E. V. Ivash. [1962] [11]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 33(038)20681] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 128: 1175-1185, Nov. 1, 1962.

Deuteron stripping differential cross sections based on the distorted wave Born approximation with diffuse-well nuclear optical potentials have been calculated for a large number of reactions, using mainly a program whose average running time on a CDC 1604 computer is about 3 sec. In general, good agreement between theoretical and experimental results has been obtained for nuclei with A 58 using nuclear parameters which are relatively constant. It has been found that best-fit elastic scattering optical parameters give good results for nuclei in this region. The effect of spin-orbit interactions on differential cross sections and on polarizations has also been examined. (Contractor's abstract)

3045

Texas U. Dept. of Physics, Austin.

QUANTUM-MECHANICAL INTEGRALS OVER GAUSSIAN ATOMIC ORBITALS, by J. C. Browne and R. D. Poshusta. [1961] [3]p. (AFOSR-1629) (Sponsored jointly by Advanced Research Projects Agency, [Air Force Office of Scientific Research under AF 49(638)-560] and Robert A. Welch Foundation of Houston, Tex.) Unclassified

Also published in Jour. Chem. Phys., v. 36: 1933-1937, Apr. 1, 1962.

Formulas for the 1-, 2-, 3-, and 4-center energy integrals are derived using the general class of single-particle Gaussian atomic orbitals $\chi = x^i y^j z^k \exp[-(\alpha_1 x^2 + \alpha_2 y^2 + \alpha_3 z^2)]$. The overlap, kinetic energy, and dipole moment integrals are given in closed form. The potential energy integrals require a 1-dimensional numerical quadrature. A technique due to Singer was used in obtaining these latter formulas. (Contractor's abstract)

3046

Texas U. Dept. of Physics, Austin.

A STUDY OF THE PHYSICS OF METASTABLE SYSTEMS, by F. A. Matsen, W. W. Robertson, and E. E. Ferguson. Final rept. Jan. 17, 1961-Jan. 31, 1962. Apr. 4, 1962, 15p. incl. tables, refs. (AFOSR-2612) (AF 49(638)569) Unclassified

This program has been concerned with the study of the energy relationships and the kinetics of excited atomic and diatomic helium. The work has included: (1) measurements of cross sections for destruction of the 2^1S and 2^3S metastable atoms of helium in ionizing collisons with the impurity atoms (Penning effect); (2) interpretation of Helium λ 10830A emission from sunlit aurorae; (3) generation of excited species by microwave discharge and measurement of decay times; (4) spectroscopic analysis of cataphoresis in He-Ne mixtures; (5) investigation of Helium afterglow by spin resonance techniques; (6) calculation of the electron collision cross section for Helium; and (7) calculation of $He(1s^2, {}^1S)$ - $He(1s2s, {}^3S)$ interaction energy. A list of the publications resulting from this research is appended.

3047

Texas U. Dept. of Physics, Austin.

REACTIONS OF THE METASTABLE HELIUM TRIPLETS, by C. Collins, W. W. Robertson and others. [1962] [1]p. [AF 49(638)500] Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 676, Feb. 20, 1962.

Excitation of the gases Ne, N_2, O_2, and CH_4 at 10 mm Hg by a stream of He gas from a microwave discharge containing the excited species $He(2^3S)$ and $He_2(^3\Sigma_u^+)$ was observed. The following reactions were identified: $^2\Sigma_u^+ - {}^2\Sigma_g^+$ of N_2^+, $^4\Sigma_g^- - {}^4\Pi_u$ and $^2\Pi_u - {}^2\Pi_g$ of O_2^+, $^2A - {}^2\Pi$ and $^2\Sigma^+ a - {}^2\Pi$ of CH.

3048

Texas U. Dept. of Physics, Austin.

CROSS SECTIONS FOR THE DE-EXCITATION OF HELIUM METASTABLE ATOMS BY COLLISIONS WITH ATOMS, by E. E. Benton, E. E. Ferguson and others. [1962] [4]p. incl. diagrs. table. (AFOSR-4384) [AF AFOSR-62-270] AD 295638 Unclassified

Also published in Phys. Rev., v. 113: 206-209, Oct. 1, 1962.

The lifetimes of metastable helium atoms He (2^3S) and He (2^1S) were measured by a time-resolved optical absorption technique in the afterglow of a pulsed helium discharge at 10-mm pressure with small concentrations of various impurity gases added. The following de-excitation cross sections in units of 10^{-16} cm^2 were determined for He(2^3S): Ne—0.28, Ar—6.6, Kr—10.3, Xe—13.9, N_2—6.4, and H_2—6.0. The uncertainties are estimated to be ±20% for the rare gases and ±50% for the molecular gases. He(2^1S) cross sections were measured to be Ne—4.1, Ar—55, Kr—64, and Xe—103, all times 10^{-16} cm^2. The neon cross section is believed reliable to ±20% but the remaining singlet cross sections may be too high by as much as a factor 2 or 3. The cross sections refer to de-excitation by ionizing collisions except in the case of neon where neon excitation occurs. Competing destruction processes render the singlet cross-section analysis somewhat uncertain except in the case of neon. (Contractor's abstract)

3049

Texas U. Dept. of Physics, Austin

CALCULATION OF CROSS SECTIONS FOR ZERO ACTIVATION ENERGY PROCESSES BY SIMPLE COLLISION MODELS WITH EMPHASIS ON THE PENNING EFFECT, by E. E. Ferguson. [1962] [3]p. incl. table, refs. (AFOSR-4385) [AF AFOSR-62-270] AD 295936 Unclassified

Also published in Phys. Rev., v. 128: 210-212, Oct. 1, 1962.

Recent cross sections obtained for the destruction of He(2^3S) metastable atoms by ionization of Ar, Kr, Xe, H_2, and N_2 are analyzed by a simple collision picture. It is found that the ratio of the experimental to momentum transfer cross sections is the same order as the efficiency of ejection of electrons from metal surfaces by He(2^3S) atoms, namely 0.2-0.3. The momentum transfer cross sections agree with the experimental values better than some of the published experimental values agree among themselves and in addition there is a great paucity of data in this area so that an order-of-magnitude estimate is often useful. In addition, it is shown that calculated momentum transfer cross sections for the reactions, $He(2^3S) + He(2^3S) \rightarrow He^+ + He(1^1S) + e^-$, $He_2^+ + Ne \rightarrow Ne^+ + 2He$, $He(1^1S) + He(n^1P) \rightarrow He(1^1S) + He(nf)$, $He(2^1S) + Ar \rightarrow He(1^1S) + Ar^+ + e^-$, agree very well with literature values of cross sections for the processes. It appears that for a broad class of atomic reactions requiring zero activation energy, a momentum transfer collision has a high probability of reaction. Momentum transfer cross sections are dominated by the long-range attractive forces and can easily be calculated, thereby providing a useful estimate of the actual reaction cross section. (Contractor's abstract)

3050

Texas U. Dept. of Physics, Austin.

IN DEFENSE OF THE USE OF ATOMIC ORBITAL CONFIGURATION WAVE FUNCTIONS FOR SMALL MOLECULES, by F. A. Matsen and J. C. Browne. [1962] [2]p. incl. diagr. tables, refs. (AFOSR-J1464) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-270] and Robert A. Welch Foundation of Houston, Tex.) AD 424345 Unclassified

Also published in Jour. Phys. Chem., v. 66: 2332-2333, Dec. 1962.

The merits of the SCF-MOC and atomic orbital configuration (AOC) methods of computing wave functions and energies for small molecules are compared. New AOC results for LiH and He_2^+ are presented in support of these views. (Contractor's abstract)

3051

Texas U. Dept. of Physics, Austin.

NEW LOWER LIMIT FOR THE BINDING ENERGY OF THE HELIUM MOLECULE ION, by P. N. Reagan, J. C. Browne, and F. A. Matsen. [1962] [2]p. incl. table (AFOSR J1466) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-270] and Robert A. Welch Foundation of Houston, Tex.) AD 426510 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 2650-2651, July 5, 1962.

An ab initio calculation based on a $^2\Sigma_u^+$ valence-bond function with terms given is carried out. Slater orbitals are used. The lower bound of 1.4 ev obtained by Hornbeck and Molnar is replaced by the theoretical lower bound of 2.045 ev.

3052

Texas U. [Dept. of Physics] Austin.

BINDING ENERGY OF He_2^+ (Abstract), by P. N. Reagan, J. C. Browne, and F. A. Matsen. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency, [Air Force Office of Scientific Research under AF AFOSR-62-270], and Robert A. Welch Foundation of Houston, Tex.) Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 174, Feb. 23, 1962.

Binding energies of 2.1 and 3.1 ev for He_2^+ have been reported from scattering measurements and spectroscopic experiments, respectively. In an attempt to resolve the

discrepancy the energy of He_2^+ has been calculated as a function of R using the following configurations $1s1s\,1s'$, $1s\,2s1s'$, $1s1s\,2p_0$, $2p_0{}^2 1s$, $1s\,2p_0\,1s$, $1s\,2p_0\,2p_0$, $2p_{\pm1}{}^2 1s$, $3d_0{}^2 1s$, $3d_{\pm1}{}^2 1s$, $3d_{\pm2}{}^2 1s$, $1s\,3d_0 3d_0$ with restricted orbital exponent optimization. The results favor the lower value. Several of the low-lying excited states of He_2^+ have also been investigated.

3053

Texas U. [Dept. of Physics] Austin.

CATAPHORESIS IN He-Ne MIXTURES (Abstract), by A. L. Schmeltekopf, E. E. Ferguson, and W. W. Robertson. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency and [Air Force Office of Scientific Research under AF AFOSR-62-270]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 115, Feb. 23, 1962.

Cataphoresis in He-Ne mixtures has been studied spectroscopically and the measurements checked by mass spectroscopic means. The effect of pressure has been investigated from 6-70 mm Hg. Wall temperature was varied from 70-500 C and current from 10-500 ma in a quartz tube of 0.500 in. diam. The results are compared with the theoretical predictions of Druyvesteyn. The effectiveness of cataphoretic separation of Ne from He has been found to increase with both pressure and current density over these extended ranges. Increased temperature markedly decreases the effectiveness of cataphoresis. The measurements were generally made in the positive column with large He to Ne ratios. In order to check for a possible 'retrograde' cataphoresis, some measurements were made with He as a minor constituent in Ne. Spectroscopic observations at the cathode appeared to indicate an enhanced He concentration there (retrograde cataphoresis). However, mass spectroscopic analysis showed that the cataphoresis, while slight, was still normal. The extreme excitation conditions at the cathode render spectral intensity interpretations difficult if not indeed misleading there

3054

Texas U. Dept. of Physics, Austin.

CONSIDERATIONS ON HELIUM EMISSION λ10830A IN AURORAE, by E. E. Ferguson. [1962] [2]p. AF AFOSR-62-270] Unclassified

Published in Planetary and Space Sci., v. 9: 280-287, May 1962.

From available measurements of Penning-type collisions from a He atom in a metastable 2^3S state (AR 6.6, Kr 10.3, Xe 13.9, N 6.4, and H 6.0 x 10^{16} sq cm) the cross section for O is estimated equal to that of N and for O to that of Kr. From these data the lifetime estimate Shefov seems to be at least 2 orders of magnitude too large. For He (2^3S) + O → He (1^1S) + O^+ + er ≈ 10 sec at 300 km and ≈ 1 sec at 200 km altitude. Thus, Shefov's assumption of λ 10,830A being due to resonant light scattering of solar photons does not account for the observed intensity of this line in auroras.

3055

Texas U. [Dept. of Physics] Austin.

CROSS SECTIONS FOR THE DE-EXCITATION OF HELIUM METASTABLES BY IMPURITIES (Abstract), by E. E. Benton and W. W. Robertson. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency and [Air Force Office of Scientific Research under AF AFOSR-62-270]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 114, Feb. 23, 1962.

A study was made of the effects of small amounts of impurities on the destruction frequencies of the 2^1S and 2^3S metastable states of helium. The optical absorption technique developed by Phelps and Pack was used for measuring destruction frequency. The resulting de-excitation cross sections of 2^3S helium metastables due to the following impurities are: 6.6×10^{-16} cm^2 (± 20%) for argon; 1.03×10^{-15} cm^2 (± 20%) for krypton; 1.4×10^{-15} cm^2 (± 20%) for xenon; 2.8×10^{-17} cm^2 (± 20%) for neon; 6×10^{-16} cm^2 (± 40%) for nitrogen; and 6×10^{-16} cm^2 (± 40%) for hydrogen. The cross section for de-excitation of 2^1S helium metastables by neon was calculated to be 4.1×10^{-16} cm^2 (± 25%). The destruction frequencies of the 2^1S state are not readily interpreted in terms of cross sections since their loss by superelastic collision with electrons is a significant process with the conditions prevailing in the discharge. The electron concentration may very well be increased by the presence of the impurity in the very early afterglow.

3056

Texas U. [Dept. of Physics] Austin.

EFFECT OF HELIUM ON THE LOW-LYING STATES OF ATOMIC HYDROGEN (Abstract), by J. C. Browne and F. A. Matsen. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency, [Air Force Office of Scientific Research under AF AFOSR-62-270], and Robert A. Welch Foundation of Houston, Tex.) Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 114, Feb. 23, 1962.

The energies of the low-lying states of the HeH system have been calculated as a function of distance from

R = 6 to 20 au. The following configurations were employed: $[(1s1s')_{He}X_H]$, where X_H = 1s, 2s, $2p_0$, $2p_+$, 3s, $3p_0$, $3p_+$, $3d_0$, $3d_+$. The approximate eigenfunctions were analyzed into "natural orbitals" which showed that the hydrogen orbitals become nonhydrogenic at quite large distances. Maxima were found in the 2s and 3s potential curves. The results are compared to those obtained from disperston theory.

3057

Texas U. [Dept. of Physics] Austin.

ELECTRON CROSS SECTION FOR HELIUM (Abstract), by H. A. Williamson and F. A. Matsen. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency, [Air Force Office of Scientific Research under AF AFOSR-62-270], and Robert A. Welch Foundation of Houston, Tex.) Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 114, Feb. 23, 1962.

Using the Exchange Distorted Boron-Oppenheimer approximation and the method of partial cross sections, the elastic scattering cross-section for slow electrons was calculated by normal helium (1^1S) and the inelastic scattering cross-section for the $1^1S - 2^3S$ transition. An open-shell wave function was used to represent the atom in the 1^1S state, and a wavefunction of the type given by Morse, Young, and Haurwitz was used for the the 2^3S state. The integro-differential equations were solved by Hulthen's variational method, using 2 distorted trial functions of the form suggested by Huang. As a consequence of the use of the open-shell configuration, both trial functions contained 3 variational parameters, one of which specified the phase shift of the distorted wave. The results compare favorably with experimental values and are slightly superior to the earlier calculations of Moiseiwitsch and of Massey and Moiseiwitsch

3058

Texas U. [Dept. of Physics] Austin.

HELIUM AFTERGLOW STUDIES BY SPIN RESONANCE TECHNIQUES (Abstract), by F. C. Fehsenfeld and E. E. Ferguson. [1962] [1]p. (Sponsored jointly by Advanced Research Projects Agency and [Air Force Office of Scientific Research under AF AFOSR-62-270]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Texas U., Austin, Feb. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7. 115, Feb. 23, 1962.

An x band electron spin resonance spectrometer has been used to analyze the afterglow of an electrodeless discharge in helium. In the experiment, the products of the discharge were flowed from the excitation region through the detection cavity of the spectrometer. A cyclotron resonance signal and an additional signal as yet unidentified have been obtained. At low pressure in a TE_{102} rectangular cavity the 2 signals were coincident and occurred near g = 2.00. However, with increasing pressure the latter signal was shifted and became resolvable. Both signals were broadened with pressure. The use of a TE_{012} cylindrical cavity resulted in a large relative enhancement of the cyclotron resonance signal. The variation of intensity and half-width of both signals with pressure and distance from the primary discharge will be reported. The observations are correlated with the processes known to occur in helium afterglows.

3059

Texas U. Dept. of Physics, Austin.

METASTABLE HELIUM ATOM CONCENTRATIONS IN THE EARTH'S ATMOSPHERE, by E. E. Ferguson and H. Schlüter. [1962] [10]p. incl. diagrs. tables, refs. [AF AFOSR-62-270] Unclassified

Published in Planetary and Space Sci., v. 9: 701-710. Oct. 1962.

Calculations of He(2^3S) metastable concentrations in the earth's atmosphere by a previously suggested process involving photoexcitation by solar UV 584 and 537A is shown to yield only ~ 5×10^5 metastables cm^2 (column) under typical twilight conditions. This is far too small to account for recent Russian twilight glow observations of resonant scattered λ 10,830A. Radiative recombination is shown to be probably more importan but still probably insufficient to account for observations. Direct excitation by photoelectrons seems to be the most likely operative metastable production mechanism. The processes of metastable destruction are considered in some detail. Cross-sections for triplet metastable destruction by O_2 and N_2 molecules are 14 and 7 x 10^{-16} cm^2, respectively, and it is estimated that the O atom cross-section is around 5×10^{-16} cm^2. (Contractor's abstract)

3060

Texas U. [Dept. of Physics] Austin.

FINITE GROUP ALGEBRAS AND QUANTUM MECHANICS, by F. A. Matsen. Oct. 1, 1962 [181]p. incl. tables, refs. (AFOSR-5522, (AF AFOSR-62-273) AD 631243 Unclassified

The purpose of this report is to present a unified algebraic theory of certain symmetry problems in quantum mechanics. In particular, it is concerned with a system whose Hamiltonian commutes with a finite group of operators. The Hamiltonian also commutes with all linear combinations of the group operators. The set of all linear combinations of the group operators constitute a group (Frobenius) algebra.

3061

Texas U. [Dept. of Psychology] Austin.

THE REPRESSION-SENSITIZATION SCALE: II. CONCURRENT AND CONSTRUCT VALIDITY, by D. Byrne. [1960] [15]p. (AFOSR-146) (AF 49(638)460) AD 611192 Unclassified

A series of studies were undertaken in order to begin the establishment of construct validity for the Repression-Sensitization Scale. It was found that the R-S Scale is negatively correlated with Ullman's Facilitation-Inhibition Scale; positively correlated with Worchel's Self Activity Inventory; negatively correlated with the California F Scale, positively related to the expression of sexual responses on the TAT for male Ss only and unrelated to the expression of aggression and emotionality for either sex; positively correlated with deviant response bias on an Adjective Check List; and unrelated to measures of intellectual ability. Thus, with minor exceptions the findings confirmed the general hypothesis that the R-S Scale is a measure of defensive behavior. (Contractor's abstract)

3062

Texas U. [Dept. of Psychology] Austin.

SELF-ENHANCEMENT AND INTERPERSONAL ATTRACTION, by P. Worchel. [1961] 18p. incl. tables, refs. (AFOSR-1464) (AF 49(638)460) Unclassified

The present series of studies on interpersonal attraction is based on the extension of the fundamental assumption of self theory, namely, that the basic drive of the individual is to maintain and enhance his self-concept, his status or self-esteem. It is contended that (a) self-enhancement produces a "readiness" to like, (b) liking is directed towards those objects or activities instrumental in producing self-enhancement, and (c) by a process of emotional conditioning, liking spreads to those objects and activities associated with the aroused emotional state. The same general relationships are predicted to hold for self depreciation and disliking. It is the purpose of the present paper to test the first and last hypotheses, namely, that self-enhancement produces liking, and that such liking spreads to associated objects.

3063

Texas U. [Dept. of Psychology] Austin.

APPROACH AND AVOIDANCE AFFILIATION MOTIVES, by D. Byrne, R. D. McDonald, and J. Mikama. [1962] 17p. incl. diagr. tables, refs. (AFOSR-J369) AF AFOSR-63-261] AD 408583 Unclassified

Also published in Jour. Personality, v. 31: 21-37, Mar. 1963.

An interpersonal affect scoring system for thematic apperception material was proposed as a possible technique for measuring approach and avoidance affiliation motives. It was shown to be sufficiently reliable for use in research. In testing a 2-factor theory of affiliation need, it was found that high "n" affiliation individuals produce stories predominating in approach motivation, medium "n" affiliation individuals produce stories with a mixture of approach and avoidance motivation, and low "n" affiliation individuals produce stories predominating in avoidance motivation. A further investigation indicated that scores on Murray's affiliation questionnaire are positively related to thematic apperception measures of "n" affiliation and the interpersonal affect index of approach motivation.

3064

Texas U. Medical Branch. Dept. of Pharmacology, Galveston.

GANGLIONIC TRANSMISSION DURING THE NEOSTIGMINE PRESSOR RESPONSE (Abstract), by J. G. Hilton. [1962] [1]p. (AFOSR-J212) (AF AFOSR-62-241) AD 400436 Unclassified

Also published in Proc. Internat'l. Union of Physiological Sciences: Twenty-second Interrat'l. Cong., Leyden (Netherlands) (Sept. 10-17, 1962), Amsterdam, Excerpta Medica Foundation, v. 2: Abstract no. 176, 1962.

It has been postulated that the pressor response elicited by neostigmine after blockade of the ganglia is due to a ganglion stimulating action of the preserved acetylcholine. To test this postulate the effects of neostigmine and atropine on ganglionic transmissio have been studied in the anesthetized dog. This study was carried out by isolating and stimulating preganglionic sympathetic nerves in the vagal trunk and recording post-superior cervical ganglionic transmission. Blood pressure change was monitored by recording femoral arterial pressures. Recordings were made upon completion of all surgical procedures prior to the administration of drugs, after the administration of a ganglionic blocking agent, after the administration of neostigmine, and after the administration of atropine. Results showed that (1) the ganglionic blocking agent caused a fall in blood pressure and a blockade of ganglionic transmission; (2) the neostigmine produced a rise in blood pressure and a blockade of ganglionic transmission; (3) the neostigmine produced a rise in blood pressure without return of ganglionic transmission and after atropine the blood pressure fell without effect upon ganglionic transmission. These results seem to invalidate the postulate that the neostigmine pressor response is due to a ganglionic action and place the site of action at some postganglionic site.

3065

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

STUDY OF A TRACER METHOD FOR SOLID PROPELLANTS. SPECTROSCOPIC DETECTION OF TRACER ELEMENTS IN SOLID PROPELLANT ROCKET EXHAUSTS, by W. Stard and B. Hornstein. Summary rept. May 24, 1960-May 23, 1961. Feb. 1962. 52p. incl. illus. diagrs. tables. (AFOSR DRA-62-6) (AFOSR-2712) (AF 29 600)2432) AD 275805 Unclassified

The feasibility of a spectroscopic method for detection of tracer elements in the exhaust flames of solid

propellant rocket engines was investigated. This technique has the possibility of being used to determine burning rates and characteristics of solid propellant grains in operating motors. This is done by relating time of appearance of specific emitted radiation in the exhaust flame with the original position of corresponding tracer salts previously incorporated within the grain. Spectrograph modification and protective measures were required for field monitoring of tracer emission in rocket exhausts of engines operating in an outdoor test installation. Suitable tracers were incorporated into solid propellant grains of 2 compositions-one aluminized to obtain high flame temperatures and background continuum radiation, the other without aluminum to provide lower temperatures and no background. Feasibility of the method was demonstrated with the detection of tracer emission from the aluminized propellant against the background radiation.

3066

Thompson Ramo Wooldridge, Inc. Ramo-Wooldridge Div., Canoga Park, Calif.

INDUCTIVE METHODS IN SEMATIC ANALYSIS; A STUDY OF INDUCTIVE METHOD IN SYNTAX, by P. L. Garvin. Jan. 22, 1962 [28]p. (Technical note no. 1) (AFOSR-1976) (AF 49(638)1128) Unclassified

This paper constitutes an attempt to render explicit the procedure followed intuitively in the conduct of the syntactic analysis of a littleknown language. It is assumed that the detailed explication of the analyst's intuitive research decisions will ultimately give a precise and reliable understanding of the process of analysis, thus leading to the formulation of an inductive research methodology for syntax. The emphasis in this approach is thus on the development of a method rather than of a form of statement. The contention is that the application of a controlled procedure will yield reliable results.

3067

Thompson Ramo Wooldridge, Inc. Ramo-Wooldridge Div., Canoga Park, Calif.

DEGREES OF COMPUTER PARTICIPATION IN LINGUISTIC RESEARCH, by P. L. Garvin. Apr. 19, 1962, 8p. (Technical note no. 2) (AFOSR-2480) (AF 49(638)1128) AD 280044 Unclassified

Presented at the Burg Wartenstein Symposium No. Eighteen of the Wenner-Gren Foundation for Anthropological Research: The Use of Computers in Anthropology, Burg Wartenstein, Austria, June 20-30, 1961.

Also published in Language, v. 38: 385-389, Oct.-Dec. 1962. (Title varies)

The criteria for rating of these computer applications is the extent to which the computer program exercises linguistic judgment. In language data collection, the computer program is not provided with any linguistic information. It is only capable of differentiating the physical shape of input units and uses the differentiation to perform a sort. In linguistic information processing and machine sentence generation, the program contains information about a particular language which permits it to differentiate certain co-occurrence properties of a language known to it and to use this differentiation for a variety of purposes. In automatic linguistic analysis, the program contains information drawn from general linguistic assumptions and methods. This information enables the program to detect co-occurrence properties of a language unknown to it. The judgment of a computer program thus consists in the increasing diversity of conditions which it is capable of taking into account in making its string of yes/no decisions.

3068

Thompson Ramo Wooldridge, Inc. Ramo-Wooldridge Div., Canoga Park, Calif.

THE IMPACT OF LANGUAGE DATA PROCESSING ON LINGUISTIC ANALYSIS, by P. L. Garvin. [1962] [7]p. (Technical note no. 3) (AFOSR-2593) (AF 49-(638)1128) AD 276401 Unclassified

Also published in Proc. Nineteenth Internat'l. Cong. of Linguists, Cambridge, Mass. (Aug. 27-31, 1962), ed. by H. G. Lunt. The Hague (Netherlands), Mouton and Co., 1964, p. 706-712.

The effect of data processing activities on the field of descriptive linguistics is evaluated.

3069

Thompson Ramo Wooldridge, Inc. Ramo-Wooldridge, Inc., Canoga Park, Calif.

LINGUISTICS, DATA PROCESSING, AND MATHEMATICS, by P. L. Garvin and W. Karush. July 9, 1962, 24p. (Technical note no. 4) (AFOSR-2866) (AF 49(638)1128) AD 277949 Unclassified

Also published in Natural Language and the Computer, ed. by P. L. Garvin. New York, McGraw-Hill, 1963, p. 357-359.

The 2 disciplines most closely concerned with language data processing are linguistics and mathematics (including mathematical logic). It is the purpose of this paper to explore how these 2 disciplines relate to each other and to language data processing. Much emphasis has been given to the significance of mathematics for the modeling and processing of natural language and a great deal of effort has been devoted to attempts at expressing linguistic relations in mathematical terms. It is clear that the attraction of higher mathematics for linguists is increasing. Often, some ambitious approaches are mathematically contrived and turn out to be linguistically sterile. Does this mean that mathematical theory is useless in natural language research, or does it mean that the mathematics has not been applied properly or that the needed mathematics has not yet been developed? These are the questions which this paper raises. This is done by comparing the 2 disciplines in the following respects: (1) the explicit methods of reasoning; (2) the [illegible]ge, as shown by the criteria used to evaluate the contributions; and (3) the mode of investigation of particular

research problems. The place of mathematics in an empirical field of science is discussed with particular reference to natural language research.

3070

Thompson Ramo Wooldridge, Inc. Space Technology Labs., Redondo Beach, Calif.

CESIUM ION BEAM NEUTRALIZATION IN VEHICULAR SIMULATION, by J. M. Sellen, Jr. and R. F. Kemp. [1961] 63p. incl. illus. diagrs. refs. (AFOSR-937) (AF 49(638)886) Unclassified

Presented at Nat'l. IAS-ARS Joint Meeting, Los Angeles, Calif., June 13-16, 1961.

A series of experiments are described which relate to the charge neutralization of a broad cesium ion beam under circumstances which simulate the conditions of space. This has been accomplished by the use of pulsed beams and by the control of the boundary conditions in such a manner as to reduce to an extremely low level the electric fields between these boundaries and the ejected plasma. In the ion engine, the period of ion turn-around has been reduced to values below the present limits of measurement (~ 1μ sec); the ejected plasma possessed a high degree of overall neutrality. The experiments also demonstrated that for fixed ion source perveance the neutralization is independent of the acceleration voltage. In considering the relationship of these experiments to the theoretical treatments of charge neutralization, 4 factors are emphasized: (1) The neutralizer configuration is of importance in the behavior of the beam; (2) There are pronounced differences between the transient behavior of the plasma and after the plasma has encountered the boundaries; (3) The energies of the electrons in the plasma in flight are of the order of volts, and the thermal energies which the electrons possess from the hot cathode are of secondary importance; and (4) Non-conservative processes, by which at least some of the electrons acquire an additional energy, are present during both the flight period and the steady state period of the plasma. These considerations point out the area toward which the experimental observations and theoretical treatments should mutually converge.

3071

Thompson Ramo Wooldridge, Inc. Space Technology Labs., Redondo Beach, Calif.

ION BEAM NEUTRALIZATION, by J. M. Sellen, Jr. Quarterly progress rept. no. 7, Dec. 1, 1961-Mar. 1, 1962. Apr. 1, 1962, 49p. incl. diagrs. (AF 49(638)886) Unclassified

Experimental and theoretical investigations are reported on: (1) measurements of the potential in a plasma ejected from an ion engine, (2) measurements of the temperature in the electron component of that plasma, and (3) development of very broad beam ion sources with perveances up to and exceeding 2×10^{-5} amps/v$^{3/2}$.

3072

Thompson Ramo Wooldridge, Inc. Space Technology Labs., Redondo Beach, Calif.

MECHANICS OF PLASMA FORMATION IN COLLISIONLESS PLASMA BEAMS (Abstract), by W. Bernstein and J. M. Sellen, Jr. [1962] [1]p. [AF 49(638)886] Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 163, Feb. 28, 1963.

The plasma potential, electron-velocity distribution, and ion density have been studied as functions of position in synthetic-plasma beams for various electron-injection conditions, and for both the pulsed, in-flight, period and the steady-state period after the plasma-front arrival at the collector. Significant differences between these periods occur when electron-injection energy is substantially larger than the energy from thermionic emission. During the in-flight period, electron-velocity distributions are non-Maxwellian in the region near the injection, and, at greater distances, attain a lower temperature, Maxwellian character. Beam divergence is determined by the high-kinetic-energy electrons present in the injection region. In steady state, electron-velocity distributions appear Maxwellian with a uniform temperature throughout the beam; this temperature is intermediate between the extremes in the in-flight situation and results in a reduced ion divergence. Ion-electron coupling is indicated in both in-flight and steady-state situations. Rapid noncollisional thermalization of electrons is indicated in the steady state. Evidence for the presence of oscillations in the plasma beam is presented.

3073

Thompson Ramo Wooldridge, Inc. Space Technology Labs., Redondo Beach, Calif.

I. SYNTHESIS OF COLLISIONLESS PLASMA BEAMS (Abstract), by J. M. Sellen, Jr. and W. Bernstein. [1962] [1]p. [AF 49(638)886] Unclassified

Presented at meeting of the Amer. Phys. Soc., Atlantic City, N. J., Nov. 28-Dec. 1, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 8: 162, Feb. 28, 1963.

Techniques have been developed for the synthesis of high directed velocity Ce-ion plasma beams. The plasma densities are such that Debye lengths are small compared to the beam dimensions, yet collison-mean-free paths are much larger than the beam dimensions. The ions are generated by contact ionization of Ce upon a hot planar W surface 2.5 cm in diam and are accelerated electrostatically by a planar W grid. The acceleration distance is variable, but is generally of the order of 1 mm. Electrons are introduced into the ion stream through fully or partially immersed W-wire neutralizers. Ion densities in the plasma range from 10^{9}-10^{10} ions/cm^{3}

and ion velocities from 2×10^6–5×10^6 cm/sec depending upon acceleration voltages. A minimum divergence angle of ~3° results from electrostatic lens effects in the acceleration; additional divergence depends upon the injection energies of the electrons. Diagnostic techniques for these plasmas are presented. Interaction of the plasma beam with solenoidal and with transverse magnetic fields is being studied. Application of these studies to exospheric phenomena is discussed.

3074

Toronto U. Inst. of Aerophysics (Canada).

INVESTIGATIONS OF AERODYNAMICALLY GENERATED SOUND, by H. S. Ribner. Final rept. Jan. 1962. 6p. (UTIA rept. no. 81) (AFOSR-2148) (AF 49(638)249) AD 288991 Unclassified

Aerodynamically generated sound is studied. Thirteen investigations were completed dealing with (1) Aeolian tones; the sound emitted by a rod in an airstream, and the associated forces; (2) boundary layer noise-rigid wall: the direct sound generated by the turbulent boundary layer of a spinning thick-walled cylinder; (3) boundary layer noise - flexible wall: the sound generated by panel vibration excited by turbulent duct flow (simulation of boundary layer flow); and (4) aerodynamic noise theory, particularly jet noise. (Contractor's abstract)

3075

Toronto U. Inst. of Aerophysics (Canada).

ON THE PREDICTION OF FATIGUE LIFE UNDER RANDOM LOADING, by E. D. Poppleton. Feb. 1962 [36]p. incl. diagrs. tables, refs. (UTIA rept. no. 82) (AFOSR-2258) (AF 49(638)548) AD 277169 Unclassified

A review is given of some current methods of estimating fatigue damage and a new damage equation is derived based on the work of Corten and Dolan, and Torbe. This equation is applied to the case of a stationary Gaussian stress history and a discussion is given of the parameters appearing in the resulting equation for the fatigue life. (Contractor's abstract)

3076

Toronto U. Inst. of Aerophysics (Canada).

REVIEW OF FATIGUE RESEARCH AT INSTITUTE OF AEROPHYSICS, by E. D. Poppleton. Final rept. Mar. 1959-Mar. 1962 [11]p. incl. illus. diagrs. (UTIA review no. 21) (AFOSR-3693) (AF 49(638)548) Unclassified

This review gives a brief description of an investigation of the fatigue of aluminum alloy specimens under random axial loading.

3077

[Toronto U. Inst. of Aerophysics (Canada)]

ELECTRON EXCITATION FOR THE PROBING OF LOW DENSITY GAS FLOWS, by E. P. Muntz, E. O. Gadamer, and D. J. Marsden. [1962] [27]p. incl. diagrs. tables. (AFOSR-3694) (AF 49(638)548) Unclassified

This paper describes the status of electron excitation as a probe for low density gas flows. The beam is most reliably used when pressures range between 0.1 μ Hg and 300 μ Hg. The primary usefulness of the probe is its ability to measure at a point in a flow the static parameters of temperature and density.

3078

Toronto U. Inst. of Aerophysics (Canada).

THEORETICAL INVESTIGATIONS OF THE DYNAMICS OF BODIES ENTERING THE ATMOSPHERE, by B. Etkin. Final technical rept. 1960-1961. Jan. 1962, 5p. (UTIA rept. no. 80) (AFOSR-2004) (AF 49(638)761) AD 272996 Unclassified

Three theoretical investigations were completed. They dealt with (1) the longitudinal dynamics of a lifting vehicle in orbital flight; (2) perturbations, caused by pitching oscillations, to the trajectory of a lifting vehicle during reentry; and (3) transition from a satellite orbit to an equilibrium glide. (Contractor's abstract)

3079

Toronto U. Inst. of Aerophysics (Canada).

RESEARCH IN MAGNETOGASDYNAMICS, by J. H. de Leeuw. Final technical rept. Mar. 28, 1962. 11p. (AFOSR-2431) (AF 49(638)823) AD 283026 Unclassified

The basic objective was the study of the flow of ionized gases with the particular purpose of considering the influence of electric and magnetic fields. A design study was made for a plasma tunnel in which the ionized gas flow is produced by passing the working gases, argon or nitrogen, through an electric arc. It was concluded that a tunnel with a cryogenic pumping system would be the most economical one for providing a capability of expanding the flow to static pressures of the order of a few μ Hg. A first project involved the study of langmuir probes for the determination of electron temperature and charged particle concentration in a low density plasma flow. Experiments performed at 2 levels of charged-particle concentration showed that the electron temperature appeared to be lower than the ion temperature. The other projects have been started involving the use of a large capacity energy storage system for the production of strong magnetic fields. This storage system is believed to be of a novel nature since it employs electrolytic capacitors without requiring a special crow bar arrangement to protect them from the reverse voltage pulse associated with the usually underdamped circuits. A description of the projects using this capacitor bank is included. The first concerns the influence of a

magnetic field on the properties of the boundary layer in an electrically conductive gas. The second is a study of the interaction of shock-ionized argon with a magnetic field.

3080

Toronto U. Inst. of Aerophysics (Canada).

THE USE OF LANGMUIR PROBES IN LOW DENSITY PLASMA FLOWS, by J. B. French, A. A. Sonin, and J. H. de Leeuw. [1962] [24]p. incl. diagrs. tables, refs. [AF 49(638)823] Unclassified

Published in Rarefied Gas Dynamics: Proc. Third Internat'l. Symposium, Paris (France) (June 1962), New York, Academic Press, Suppl. 2, v. 2: 471-494, 1963. (AFOSR-5310)

An experimental study of Langmuir probes which are small in relation to neutral particle mean free paths is presented. The probes were studied in a moderately supersonic plasma stream at high and low ion concentrations. Probe theory is reviewed and extended, and by comparison with experiment it is indicated that these small probes can be used for the determination of plasma properties when care is exercised in ascertaining the conditions to which the probe is subjected. In particular, the charged particle mean free paths in terms of the probe size and the ratio of electron-to-ion temperature are of importance. The probes were used in the study of the stagnation region in front of a blunt body. (Contractor's abstract)

3081

Toronto U. Inst. of Aerophysics (Canada).

A HIGH-SPEED MULTI-SOURCE SPARK CAMERA, by J. H. de Leeuw, I. I. Glass, and L. E. Heuckroth. Feb. 1962 [58]p. incl. illus. diagrs. refs. (UTIA technical note no. 26) (AFOSR-3088) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)823, Defence Research Board of Canada, and Office of Naval Research) Unclassified

Some details are given of the design, operation, and applications of an 8 channel Cranz-Schardin type high-speed multiple spark source camera suitable for optical studies of nonstationary flow phenomena in gases and transparent liquids and solids. The camera has been successfully applied to the investigation of cylindrical and spherical explosions and implosions, underwater blasts, stress waves in plastics and impact in glass panels.

3082

Toronto U. Inst. of Aerophysics (Canada).

ATTITUDE STABILITY OF ARTICULATED GRAVITY-ORIENTED SATELLITES. PART I. GENERAL THEORY, AND MOTION IN ORBITAL PLANE, by B. Etkin. Nov. 1962 [48]p. incl. diagrs. tables. (UTIA rept. no. 89) (AF AFOSR-62-40) AD 299840 Unclassified

A theoretical framework is presented for analyzing the rotational and relative motions of compound satellite systems. It consists essentially of expressions derived for the forces and moments acting on the constituent bodies, and of their utilization in Lagrange's equation to find the equations governing the motion of the system. The method is applied to a specific system intended for passive attitude stabilization, and numerical examples are calculated. The design is found to provide damping to 1/2 amplitude in as little as 1/3 of an orbit, and to have small response to orbit ellipticity.

3083

Toronto U. Inst. of Aerophysics (Canada).

A NUMERICAL SOLUTION FOR THE FREE-MOLECULE IMPACT-PRESSURE PROBE RELATIONS FOR TUBES OF ARBITRARY LENGTH, by J. H. de Leeuw and D. E. Rothe. Dec. 1962 [49]p. incl. diagrs. tabes. (UTIA rept. no. 88) (AFOSR-4694) (AF AFOSR-62-98) AD 401240 Unclassified

A numerical analysis was made of the free-molecule impact-pressure probe relations for circular tubes at zero angle of attack. A computer program was written, and the calculations were carried out by an IBM-650 electronic computer for specific speed ratios in the range between zero and twenty and for tube geometries varying from an orifice to an infinitely long tube. Graphs and data are presented. The impact-tube relations used were originally developed in UTIA rept. no. 52 by Harris and Patterson, who assumed a Maxwellian random motion of the gas molecules entering the tube and diffuse reflection of the molecules from the tube walls.

3084

Toronto U. Inst. of Aerophysics (Canada).

THE FREE-MOLECULE IMPACT-PRESSURE PROBE OF ARBITRARY LENGTH, by D. E. Rothe and J. H. de Leeuw. [1962] [2]p. incl. diagr. (AF AFOSR-62-98) Unclassified

Published in AIAA Jour., v. 1: 220-221, Jan. 1963.

This note is written to supplement the work recently published by Pond (Jour. Aerospace Sci., v. 29, Aug. 1962) The results reported agree with Pond's where comparison is possible, but were obtained by a completely independent and different analysis of the underlying theory late in 1961. Calculations were performed with the aid of an IBM-650 computer for specific speed ratios between 0 and 20 and for tube geometries ranging continuously from an orifice to an infinitely long tube.

3085

Toronto U. Inst. of Aerophysics (Canada).

AN EXPERIMENTAL INVESTIGATION OF THE SOUND GENERATED BY THIN STEEL PANELS EXCITED BY TURBULENT FLOW (BOUNDARY LAYER NOISE), by G. R. Ludwig. Nov. 1962, 1v. incl. illus. diagrs. tables, refs. (UTIA rept. no. 87) (AFOSR-4740) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)249 and AF AFOSR-62-267 and Defence Research Board of Canada) Unclassified

The sound power radiated by a series of 11- x 11-in. steel panels excited by fully developed turbulent channel flow has been studied. Four thicknesses of panel were used: 0.0015, 0.002, 0.004, and 0.008 in. Two long acoustically quieted air ducts of 8- x 12- and 1- x 12-in. inside cross sections were used to provide the turbulent flow. The maximum flow speed at the duct center line was about 180 fps. The acoustic efficiency, defined as radiated acoustic power divided by boundary-layer friction power, has been calculated for the various panels. These efficiencies are compared to those of a jet and of a turbulent boundary layer on a rigid wall. For low subsonic Mach numbers and thin panels, the efficiencies attained were greater than that of a turbulent boundary layer on a rigid wall by at least a factor of 10 and greater than that of a jet by a factor of more than 100. Extrapolation of the test data to include high subsonic Mach numbers and thicker panels suggests that the flexible panel mechanism for generating sound may prove relatively more efficient than the other 2 mechanisms over a fairly wide range of these parameters.

3086

Toulouse U. (France).

[RESEARCH ON THE VOLUME[T]RIC REGULATION OF THE ALDOSTERONE SECR[ETION] Recherches sur la régulation volumetrique de la sécrétion de l'aldostérone, by A. Baisset, L. Douste-Blazy and others. [1962] [6]p. incl. diagrs. (AFOSR-J181) (AF 61(052)-411) AD 400052 Unclassified

Also published in Ann. Endocrinol., v. 23: 419-424, 1962.

The effects of auricular distention on the secretion of aldosterone in the normal dog before and after vagotomy, decerebration, hypophysectomy, and hypothalamic lesions were studied. It was noticed in the anesthetized dog that distention of the right auricle diminishes the aldosterone secretion by at least 50%. This effect is suppressed by vagotomy or posterior hypothalamic lesions, but it is maintained after hypophysectomy or anterior hypothalamic lesions. Distention of the left auricle did not influenced aldosterone secretion.

3087

Training Center for Experimental Aerodynamics, Brussels (Belgium).

MATHEMATICAL STUDY ON KINETIC THEORY OF GASES APPLIED TO LOW DENSITY HIGH SPEED FLOW, by J. J. Smolderen. Final rept. Jan. 31, 1962, 5p. (AFOSR-2490) (AF 61(052)486) AD 289458 Unclassified

The solution of a simplified form of the unsteady shock problem, using a more schematic discontinuous distribution function as suggested by Lees in his treatment of the Rayleigh problem, has been obtained. Also, a general discussion of the mathematical type of the partial differential systems obtained for various choices of moment equations has been made. The study of the singularity obtained earlier has been started for the case of the 1-dimensional model. The various approximations methods available for the treatment of the Boltzmann equation are compared, particularly those based on the moment equations. Finally, the study of steady state boundary condition problems for the linearized model equation was initiated. The equation is found to be of singular parabolic type according to the terminology of Gevrey.

3088

Training Center for Experimental Aerodynamics, Brussels (Belgium).

A ONE DIMENSIONAL MATHEMATICAL MODEL FOR THE BOLTZMANN EQUATION, by J. J. Smolderen. Oct. 1962, 56p. incl. diagr. refs. (Technical note no. 10) (AFOSR-4368) (AF 61(052)486) Unclassified

A 1-dimensional model for the Boltzmann equation of kinetic theory of gases is proposed, in order to study the validity of the usual approximation method and the behavior of the solutions near the free molecule limit. The interaction term is very similar to the Fokker Planck term. The conservation of mass, momentum and energy results from the particular form assumed for the interaction term and the only equilibrium solutions are shown to be of Maxwell-type. Hydrodynamic equations similar to the Navier-Stokes-Fourier equations are derived in the usual way under the asuumption of small gradients. Shock waves are shown to exist in supersonic flows. The distribution function is obtained in the case of a spatially uniform condition and the existence of an infinite number of a relaxation modes and corresponding relaxation times is shown. The linearized versions of the model equation are established with particular emphasis on the simplest problesm of heat conduction and wave propagation and the usefulness of Fourier transformation with respect to the velocity component is indicated. Finally, the behavior of the solutions near the free molecule limit is briefly investigated for steady state conditions. Existence of a singular behavior for slow molecules, analogous to boundary layer phenomenon, is indicated and the equation is shown to reduce to a singular parabolic equation

studied by Gevrey, in the region of interest. The leading terms in the deviation from free molecule data are found to be of the order of the cube root of an interaction parameter, playing a role analogous to the Knudsen number.

3089

Training Center for Experimental Aerodynamics, Brussels (Belgium).

LAMINAR SEPARATION IN SUPERSONIC FLOW, by J. J. Ginoux. Final rept. Dec. 1, 1961-Sept. 30, 1962 [45]p. incl. illus. diagrs. tables. (AFOSR-4238) (AF EOAR-62-52) AD 292901 Unclassified

A preliminary experimental investigation has been made of the effect of 3-dimensional flow perturbations on the heat-transfer rate in the reattachment region of a laminar flow behind a 2-dimensional backward-facing step. It was found that the mean value of the heat-transfer rate was increased by as much as 70% by the presence of strong flow perturbations, while the recovery factor increased approximately from the laminar value ($\sqrt{P}^2$) to the turbulent one ($\sqrt{P}^2$). A novel technique of heat-transfer measurements was used, by which heat was uniformly dissipated on the surface of the model. A theory has been developed for the case of a supersonic flow over a flat plate, which gives an exact solution of the boundary layer equations when heat is uniformly dissipated on the surface. It was shown in particular that the ratio of the heat transfer coefficient for an isothermal wall to the heat-transfer coefficient for uniform heat-flux is a constant independent of Mach number and Reynolds number. Numerical integration showed that it is equal to 0.72; independently of the Prandtl number in the range 0.5 to 1.0. (Contractor's abstract)

3090

Trieste U. [Mathematical Inst.] (Italy).

ON THE NONSTATIONARY NAVIER-STOKES SYSTEM, by T. Kato and H. Fujita. [1962] [18]p. (AFOSR-4372) (AF EOAR-62-7) AD 295874 Unclassified

Also published in Rend. Sem. Matem. Univ. Padova, v. 32: 243-260, 1962.

A number of works have been published on the initial value problem for the nonstationary Navier-Stokes equations. As yet the existence of a global solution (in time) has not been proved for the 3-dimensional flow for sufficiently general initial conditions; but it now appears that the existence and uniqueness of a genuine solution which is local in time have been established. An attempt is made to deduce an existence and uniqueness theorem by means of Hilbert space theory. The ultimate objective is proof of the theorem in its classical form. As a preliminary step to this goal, a somewhat weaker form is proved as an existence and uniqueness theorem on the initial value problem of the Navier-Stokes equation regarded as a nonlinear operator equation in an appropriate Hilbert space.

3091

Trieste U. [Mathematical Inst.] (Italy).

[THEOREM OF LOCAL CHARACTER FOR THE NAVIER-STOKES SYSTEM AND STABILITY OF STATIONARY SOLUTIONS] Teoremi de tipo locale per il sistema de Navier-Stokes e stabilita delle soluzioni stazionarie, by G. Prodi. [1962] [24]p. incl. refs. (AFOSR-4373) (AF EOAR-62-7) Unclassified

Also published in Rend. Sem. Matem. Univ. Padova, v. 32: 374-397, 1962.

This work is a study of the Navier-Stokes system

$$\frac{\partial u}{\partial t} = (u \cdot \text{grad})u - \Delta u = - \text{grad } p + f$$
$$\text{div } u = 0 \quad (u = (u_1, u_2, u_3))$$

in a 3-dimensional bounded open set. Existence and uniqueness theorems, of local character with respect to t, are given for the mixed problem. The approach to the problem is similar to Sobolewski's; but some improvements are supplied by a more direct method. With a view to applications to other problems, there is an estimate of the interval where the existence of the solution is assured. The problem of stability of stationary solutions is considered, more exactly it is proved that, if the variation operator associated to a stationary solution u^* has the whole spectrum with positive real part, the solution u^* is asymptotically stable. This statement is implicitly assumed in all the papers but there was no evidence that it has been proved.

3092

Tufts U. Dept. of Chemistry, Medford, Mass.

PYROLYSIS OF ALLYLIC ACETATES. II, by F. L. Greenwood. [1962] [4]p. incl. refs. (AFOSR-2120) (AF 49(638)292) Unclassified

Also published in Jour. Org. Chem., v. 27: 2308-2311, July 1962.

2-Acetoxy-trans-3-hexene and 4-acetoxy-trans-2-hexene have been pyrolyzed under conditions that gave partial pyrolysis. Both esters gave rise to a mixture of 1,3- and 2,4-hexadiene, the 2-acetoxy compound giving somewhat more of the 1, 3-diene and the 4-acetoxy compound giving more of the 2,4-diene. The 1,3-diene was predominantly the trans isomer, and about half of the 2,4-diene was the trans, trans isomer. The unpyrolyzed ester recovered in each case was the same mixture of 2-acetoxy and 4-acetoxy compounds. Clearly, the esters underwent isomerization during the pyrolysis, and in this isomerization the trans-alkene configuration was essentially retained. (Contractor's abstract)

3093

Tufts U. Dept. of Chemistry, Medford, Mass.

THE MOLOZONIDE AS AN INTERMEDIATE IN THE ALKENEOZONE REACTION, by F. L. Greenwood and S. Cohen. [1962] [2]p. (Contribution no. 290) (AFOSR-J664) (AF 49(638)292) AD 415477 Unclassified

Also published in Jour. Org. Chem., v. 28: 1159-1160, Apr. 1963.

3-Octene (cis- and trans-) (I) (20 mM) was ozonized in 40 ml pentane at -95° with 18 mM O_3, and the mixture warmed to -85° (mild eruption), the crystals disappeared, and the temperature was -65°. The ozonation mixture was 40 mM of I and 38 mM O_3 treated at -95° with 440 mM isopropyl Grignard reagent, and the product distilled gave (possible test for α-glycol) 15.1 mM of 2-methyl-3-pentanol (II), bp_{29} 52°, n_D^{25} 1.4148 (3,5-dinitrobenzoate mp 89.4-90.2°) and 17.3 mM of 2-methyl-3-heptanol, bp_{29} 83°, n_D^{25} 1.4240. trans-3-Hexene (38 mM) similarly treated at -115° with O_3, then with 342 mM of isopropyl Grignard reagent and the product distilled, gave 17.3 mM of dl-hexane-3,4-diol [bis(3,5-dinitrobenzoate) mp 166.2-167.40], 15.6 mM of II, and 101 mM of iso-PrOH. Similarly, 36.7 mM cis-3-hexene gave 47.0 mM II and 21.8 mM iso-PrOH. These results indicated that the molozonide was an existing species at a sufficiently low temperature. The mechanism of the reaction was discussed.

3094

Tufts U. Inst. for Psychological Research, Medford, Mass.

INNOVATION IN TASK ORIENTED COMMUNICATION, by T. B. Roby. Final rept. Aug. 1962 [15]p. (AFOSR-J1372) (AF AFOSR-62-372) AD 428333 Unclassified

The objective of this project was to examine the processes whereby people develop a new language to deal with a distinctively new environment or task. The impetus for this research came from the observation that whenever a new technological development is introduced, the people most closely connected with it—for example, technicians and operators—very rapidly develop a convenient, concise jargon which permits them to express themselves and to cope with whatever the coordinative requirements of the task may be. Typically, of course, this language innovation is based upon a transfer of existing language elements. The present study them is prepared to set up such conditions deliberately and in a controlled way, and to study the determinants of the new language construction as well as to study the form that the language itself takes. The results of this study indicated better performance for the 2-way conversation condition. It also indicated differences in stimulus materials: the polygon for which the variations were more pronounced were easier to identify than those in which fine details had to be differentiated. (Contractor's abstract)

3095

Tufts U. Inst. for Psychological Research, Medford, Mass.

HUMAN ENGINEERING BIBLIOGRAPHY. 1960-1961, Oct. 1962 [344]p. (ONR rept. no. ARC-75) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-49413) AD 401667 Unclassified

Features of this compilation of references to human factors include: (1) Human engineering: methods, facilities, equipment, and general references; (2) Systems of men and machines; (3) Visual inputs and processes; (4) Auditory input and processes, including speech production and intelligibility. (5) Other sensory inputs and processes; (6) Input channels: choice and interaction; (7) Body measurements, basic physiological limits in motor performance, basic motor capacities, and perceptual motor skills; (8) Special environmental factors affecting performance; (9) Other individual factors, work conditions, and task characteristics that affect behavioral efficiency; and (10) Training aids and devices and their use.

3096

Turin U. (Italy).

ON THE GREEN'S FUNCTION OF POTENTIAL SCATTERING, by M. Verde. Final rept. Sept. 29, 1962 [37]p. (AFOSR-4055) (AF 61(052)230) AD 290687 Unclassified

Also published in Nuovo Cimento, v. 24: 547-566, May 1963.

The Green's function in some potential scattering problems of spherical symmetry is written as an integral of the product of the Green's function Ga corresponding to the angular variables and Gr corresponding to the radial variables. The integration is carried along a suitable line C in the plane of complex angular momentum. If C surrounds the spectrum of Ga, the usual partial waves expansion is obtained if C surrounds the spectrum of Gr, a different expansion results which is the most suitable for describing collisions involving small wave lengths.

3097

Turin U. (Italy).

DYNAMICAL EQUATIONS AND ANGULAR MOMENTUM, by V. De Alfaro, T. Regge, and C. Rossetti. [1962] [34]p. incl. diagr. table, refs. (AF 61(052)230) Unclassified

Published in Nuovo Cimento, Series X, v. 26: 1029-1062, Dec. 1, 1962.

In this paper the potential scattering is described in terms of Jost functions $F(\lambda, s)$ of the variables λ (angular momentum) and s (energy). In particular the connection between analytic properties of $F(\lambda, s)$ and double dispersion relation plus unitarity for the transition amplitude is discussed. It is found that all these properties can be condensed into an integral representation for $F(\lambda, s)$ and a nonlinear identity. This identity contains rougly the same amount of information of Khuri's dispersion relations for the scattering amplitude in the energy at fixed transmitted momentum. From this identity and the integral representation it is possible to construct $F(\lambda, s)$ in much the same way as Blankenbecler et al. are constructing the double spectral function for the transition amplitude in the variables s, t. The advantage of working on the mass shell, is paid

for by the nonlinearity of these equations. It should be pointed out that in this method there are no subtraction troubles and that it is possible to determine the location of bound states and resonances.

3098

Turin U. (Italy).

HOLOMORPHY DOMAIN OF THE S-MATRIX IN POTENTIAL SCATTERING, by A. Bottino and A. M. Longoni. [1962] [16]p. incl. diagrs. [AF 61(052)230] Unclassified

Published in Nuovo Cimento, v. 24: 353-368, Apr. 1962.

This is a study of the holomorphy domain of the S-matrix in the case of potentials V(z), analytic and conveniently bounded in the right half plane of z, using a method given by T. Regge (Nuovo Cimento, v. 19: 647, 1960).

3099

Turin U. (Italy).

THE MAXIMUM ANALYTICITY PRINCIPLE IN THE ANGULAR MOMENTUM, by E. Predazzi and T. Regge. [1962] [16]p. [AF 61(052)230] Unclassified

Published in Nuovo Cimento, v. 24: 518-535, May 1962.

Chew has proposed to extend this maximum analyticity principle to angular momentum. So far analyticity of the scattering amplitude in the angular momentum has been proved for potential scattering only when Re ( ) > - . According to Chew it ought to be possible to extend this analyticity in the whole plane, apart from those singularities which have a clear physical interpretation in terms of dynamical resonances or bound states. In this paper it is shown that a potential with a strongly repulsive core may be the way out of the dilemma in the sense that the resulting amplitude is then even in (+) and the desired analytical continuation is then trivial.

3100

Turin U. (Italy).

PHASE SHIFTS AND MODEL POTENTIALS, by M. Verde. [1960] [11]p. (AF 61(052)230) Unclassified

Published in Beitrage zur Entwicklung der Physik, ed. by H. Frauenfelder, O. Huber, and P. Stahelin. Basel. Birkhauser Verlag, 1960, p. 231-241. (Helv. Phys. Acta, Suppl. 5)

Here is a brief discussion of the problem of fundamental interest in nuclear physics, concerning the correspondence of a set of measured phase shifts as a function of the energy in an elastic scattering, to a possible potential which may serve as a model to describe a nuclear collision. It is quantitatively demonstrated that the asymptotic behavior of the potential at large distances is very sensitive to the position and the nature of singularities of the scattering matrix S(E), as function of the energy E^2. On the other hand, any knowledge of the potential at small distances, if deduced from s-eigenwaves, only, is insensitive to the analytical properties of S(E) at low energies. Since a large number of partial waves are involved in high energy collision data, it is necessary to generalize in order to establish a correspondence between a model potential and the analytical behavior of the total scattering amplitude as function of the scattering angle at a fixed energy. The necessary mathematical tool consists in relating the model potential U(x) to some appropriate kernels $K_e(x, x')$ and $K_i(x, x')$

$$K_e(x, x) = \int_x^\infty U(x')dx', \quad K_i(x, x) = \int_0^x U(x')dx'$$

K_e and K_i are respectively called the kernels of Marchenko and of Gel'fand and Levitan. In the final section it is indicated how the Gel'fand and Levitan equation and the corresponding equation for the outgoing waves can be derived.

3101

Tuskegee Inst. George Washington Carver Foundation, Ala.

ALPHA-FLUOROALKYL THIOETHERS, by C. T. Mason. Final rept. Mar. 1962, 43p. incl. tables. (AFOSR-2398) (AF 49(638)283) AD 419526 Unclassified

Fundamental research on halogenated thioethers (sulfides) is reported. The primary idea of the research is to investigate the properties of new fluoromethyl thioethers and to compare their properties with those of the chlorine analogues. A series of so far unreported fluoromethyl n-alkyl sulfides was prepared from the corresponding chloromethyl alkyl sulfides. Their chemical properties are discussed. (Contractor's abstract)

3102

United States Rubber Co., Wayne, N. J.

DECAY OF Sm^{156} (Abstract), by R Gunnink. [1962] [1]p. [AF 49(638)815] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 353, Apr. 23, 1962.

Also published in Phys. Rev., v. 131: 301-304, July 1, 1963.

The radiations following the decay of 9.4 ± 0.2 hr Sm^{156} have been studied using techniques of scintillation spectrometry and 4π-β counting. The isotope was produced by fissioning natural uranium in a high neutron flux and, except for Sm^{153}, was separated from other fission products by radiochemical techniques. The following γ-rays were observed in the decay of Sm^{156}: 38 kev, x-rays (~ 20%), 87 kev (40%), 165 kev (18%), 203 kev (29%), and 255 kev (5%). The 87-kev γ transition was found to be in coincidence with both the 165- and 203-kev γ transitions. Its K-shell conversion coefficient is 0.35 ± 0.02. Angular-correlation studies indicated the 87-203 kev γ anisotropy to be about -0.27 and the 87-165 kev γ anisotropy to be < 0.1. Fermi plots of the β spectra coincident with the 165- and 203-kev γ rays produced identical end points of 430 ± 10 kev. Another β group, 45% in abundance, had an end point of 715 ± 15 kev, and presumably goes to the ground state of Eu^{156}. Interpretation of the data and alternative decay schemes is discussed.

3103

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

A SYSTEM FOR AUTOMATIC DENSITOMETRY FOR THE MEASURING AND CALCULATION OF RADIATION DOSE DISTRIBUTIONS, by B. G. Karlsson and B. Larsson. Feb. 20, 1962, 12p. incl. diagrs. tables. (Technical note no. 3) (AFOSR-2669) (AF 61(052)183) AD 276062 Unclassified

The usefulness of the method of experimental radiosurgery of the brain depends on a careful planning of the operative procedure, the shape of the lesion being related to the distribution of isodose curves in the tissue. A system for automatic densitometric measurements was developed which permits automatic evaluation of dose distributions in volumes of various size by means of photographic emulsions or in-phantom chemical dosimeters. The apparatus is also convenient for the semi automatic calculation of dose distributions in multiple field procedure. (Contractor's abstract)

3104

Uppsala U. [Gustaf Werner Inst. for Nuclear Chemistry] (Sweden).

HISTOLOGY OF THE SURGICAL RADIOLESION IN THE HUMAN BRAIN AS PRODUCED BY HIGH ENERGY, by W. Mair, B. Rexed, and P. Sourander. [1962] [6]p. incl. illus. (Technical note no. 4) (AFOSR-3480) (AF 61(052)183) AD 284931 Unclassified

Presented at Symposium on High Energy Protons, Harrogate, Yorkshire, (Gt. Brit.) Aug. 1962.

Changes in the mid brain of a man following irradiation were studied on one side of the spinothalamic tract region by high energy protons to relieve pain. The man was 59 and suffered from intractable pain due to cancer of the lung with spread to the axilla and the supraclavicular region. The irradiated region was sharply demarcated being ovoid in shape with a crenated border. Destruction of myelin sheaths, axons, astrocytes and oligodendroglia occurred in the irradiated region and some tiny perivascular haemorrhages were present. Nuclear debris and collections of macrophages were found at the edge of the necrosis. Little proliferation of astrocytes was seen 9 weeks after irradiation. The changes were exactly similar to those seen in goats 7 and 4 weeks after irradiation with the same dose. Tiny, discrete, rounded, zones of necrosis were seen in man just rostral to the confluent necrosis. They are presumably the result of interesecting beams as they pass to the center of irradiation.

3105

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

MORPHOLOGICAL STUDIES ON PERIPHERAL NERVES EXPOSED TO A BEAM OF HIGH ENERGY PROTONS, by R. Bergström. [1962] [3]p. incl. table. (AFOSR-4193) (AF 61(052)183) AD 406821 Unclassified

Also published in Acta Pathol. et Microbiol. Scand., Suppl. 154: 80-81, 1962.

The experiments indicate that the resistance of rat nerves to proton irradiation is comparatively large and that their regenerative power is good. The development of paresis appears not only to be dependent on the size of the dose but also on the width of the beam. (Contractor's abstract)

3106

Uppsala U. Inst. of Chemistry (Sweden)

BORIDES OF RUTHENIUM, OSMIUM AND IRIDIUM, by B. Aronsson, E. Stenberg, and J. Aselius. (Technical note no. 32) May 21, 1962, [6]p. incl. tables. (AFOSR-2785) (AF 61(052)40) AD 281221 Unclassified

Also published in Nature v. 195: 377-378, July 28, 1962.

The work by Buddery and Welsh (Nature, v. 167: 362. 1951) on the composition of the intermediate phases in the binary system of boron with the platinum metals is extended by the study of crystal structure using powder photographs of arc-melted alloys. The results of Kempter and Fries, (Jour. Chem Phys. v. 34: 1994, 1961) that there are phases with the W_2B_5-type structure in the Ru-B and Os-B systems and that the boron content of these phases is smaller than 71.4 at-% (Me_2B_5) were confirmed. More thorough investigation should make it possible to determine if $RuB_{1.1}$ and $OsB_{1.2}$ are cubic or hexagonal and the crystal structure of $RuB_{2.1}$ and $OsB_{2.2}$.

3107

Uppsala U. Inst. of Chemistry (Sweden).

X-RAY STUDIES OF MOLYBDENUM AND TUNGSTEN PHOSPHIDES, by S. Rundqvist and T. Lundström. [1962] [10]p. incl. diagrs. tables, refs. (Technical note no. 33) (AFOSR-2993) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 278177 Unclassified

Also published in Acta Chem. Scand., v. 17: 37-46, 1963.

The Mo-P and W-P systems have been studied by x-ray powder methods. In addition to the previously reported phases Mo_3P, MoP MoP_2, WP, and WP_2, the occurrence of a phase with the approximate composition $MoP_{0.75}$ has been established. The unit cell dimensions for Mo_3P, MoP, and WP have been redetermined. Some data supporting the hypothesis of an ordered distribution of phosphorus atoms in MoP (WC-type structure) are given. The structures of the isostructural MoP_2 and WP_2 have been determined, and the MoP_2 structure has been refined from x-ray powder data. The orthorhombic unit cell dimensions (in A) are for MoP_2: a = 3.145; b = 11.184; c = 4.984; and for WP_2: a = 3.166, b = 11.161; c = 4.973. The space-group is $Cmc2_1$ with 4 metal atoms and 8 phosphorus atoms in 3 sets of fourfold positions. The structure is related to the $ZrSi_2$ (C 49) type. (Contractor's abstract)

3108

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURES OF Rh_2Si AND Rh_5Si_3 WITH SOME NOTES ON THE Rh-Si SYSTEM, by I. Engstrom. [1962] [10]p. incl. diagrs. tables, refs. (AF 61(052)40) Unclassified

Published in Acta Chem. Scand., v. 17: 775-784, 1963.

The crystal structures of Rh_2Si and Rh_5Si_3 have been refined from single crystal data. For Rh_2Si (C23 type), the unit cell dimensions are a = 5.40_8 A, b = 3.93_0 A, and C = 7.38_3 A, and the atomic parameters are Rh_I in 4(c): x = 0.8393, z = 0.0694; Rh_{II} in 4(c): x = 0.9726, z = 0.6991; Si in 4(c): x = 0.2819, z = 0.1052. For Rh_5Si_3 (Rh_5Ge_3- type), the unit cell dimensions are a = 5.31_7 A, b = 10.13_1 A and c = 3.89_5 A, and the atomic parameters are Rh_I in 2(c); Rh_{II} in 4(g): x = 0.1542, y = 0.2158; Rh_{III} in 4(h): x = 0.3297, y = 0.3936; Si_I in 2(a); Si_{II} in 4(h): x = 0.3917, y = 0.1505. A hexagonal phase with the composition $Rh_{\sim 1.5}Si$ and the unit cell dimensions a = 11.85_1 A, c = 3.62_3 A is reported. (Contractor's abstract)

3109

Uppsala U. [Inst. of Chemistry] (Sweden).

INORGANIC ADDUCT MOLECULES OF OXO-COMPOUNDS, by I. Lindqvist. Technical final rept. Jan. 1, 1958-June 30, 1962 [256]p. incl. diagrs. refs. (AFOSR-3135) (AF 61(052)43) AD 281904 Unclassified

This report includes the following topics: (1) Conditions for adduct molecule formation; (2) Characteristic coordination numbers; (3) Structural evidence concerning donor molecules; (4) Adducts with donor molecules containing the groups (= C = 0) and Adducts with donor molecules containing the group (---As = 0); (5) Adducts with Bronsted acids; (6) Ternary adducts with carboxylic acids; (7) Adduct molecules in the liquid state and in solutions; (8) Affinity studies and structural data; (9) Charge distribution; (10) Decomposition of adduct molecules; (11) Catalytic activity of acceptor molecules; (12) Theory for donor acceptor interaction with oxo-compounds; (13) Donor-acceptor interaction; and (14) Bond length differences.

3110

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURES OF THE ADDUCTS $SbCl_5 \cdot POCl_3$, $SbCl_5 \cdot (CH_3)_3PO$ AND $NbCl_5 \cdot POCl_3$, by C.-I. Branden and I. Lindqvist. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-64-1551) (AF 61(052)43) AD 446116 Unclassified

Also published in Acta Chem. Scand., v. 17: 353-361, 1963.

A further refinement of the crystal structures of $SbCl_5 \cdot POCl_3$ and $SbCl_5 \cdot (CH_3)_3PO$ is reported, together with the structure determination of $NbCl_5 \cdot POCl_3$. The 3 compounds are isotypic. The crystal structures of $SbCl_5 \cdot POCl_3$ and $SbCl_5 \cdot (CH_3)_3PO$ have already been determined and refined by Fourier methods. These refinements have now been carried a stage further using a least-square method which has also been used in the refinement of the structure of $NbCl_5 \cdot POCl_3$. (Contractor's abstract)

3111

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF $SnCl_4 \cdot 2POCl_3$, by C.-I. Brändén. [1962] [10]p. incl. diagr. tables, refs. (AF 61(052)43) Unclassified

Published in Acta Chem. Scand., v. 17: 759-768, 1963.

The crystal structure of $SnCl_4 \cdot 2POCl_3$ has been determined and refined from 3-dimensional x-ray data. The structure comprises discrete molecules of $SnCl_4 \cdot 2POCl_3$. The tin atom is octahedrally coordinated with the two $POCl_3$ groups lying in the cis-position. The oxygen atom in each $POCl_3$ group functions as a donor atom. The two $POCl_3$ groups in the molecule are crystallographically different but both preserve their approximately tetrahedral structure. (Contractor's abstract)

3112

Uppsala U. Inst. of Mathematics, (Sweden).

RESEARCH ON INTERPOLATION PROBLEMS, by L. Carleson. [Final rept.] June 1, 1962, [42]p. (AFOSR-2972) AF 61(052)238) AD 278144 Unclassified

In a paper by Carleson (1958), a new method to study interpolations by bonded analytic functions was introduced. The results of this paper have been shown to hold in arbitrary domains of finite connectivity. Corresponding results have been obtained for other H^p-classes and for the class of uniformly continuous functions. Finally, the method has been used to prove the corona conjecture on the maximal ideal space of H^∞.

3113

Uppsala U. Inst. of Mathematics (Sweden).

INTERPOLATIONS BY BOUNDED ANALYTIC FUNCTIONS AND THE CORONA PROBLEM, by L. Carleson. [1962] [3]p. [AF 61(052)238] Unclassified

Published in Proc. Internat'l. Cong. of Mathematicians, Stockholm (Sweden) (Aug. 15-22, 1962) Djursholm, Institut Mittag-Leffler, 1963, p. 314-316.

A summary of results of the author's paper in Ann. Math., v. 76: 547-559, is presented. (See item no. 3114, Vol. VI.) (Math. Rev. abstract)

3114

Uppsala U. Inst. of Mathematics (Sweden).

INTERPOLATIONS BY BOUNDED ANALYTIC FUNCTIONS AND THE CORONA PROBLEM, by L. Carleson. [1962] [13]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052) 238] and National Science Foundation) Unclassified

Published in Ann. Math., v. 76: 547-559, Nov. 1962.

This paper contains a number of results related to the theory of interpolation in H^p spaces, where $p > 1$. Letting $G(z)$ be an element of H^p with norm $\| G \|_p$ and letting $\mu(z)$ be a positive measure on $|z| < 1$, the author first considers the problem of determinating a condition on μ necessary and sufficient for the existence of a constant C such that $\int |G(z)|^p_p \, d\mu(z) \leq C \cdot \| G \|^p_p$ for all G in H^p. He is able not only to determine such a condition (which says that the ratio of the measures of certain annular wedges to their angles be bounded) but to apply it to the construction of regions in which a given Blaschke product is neither too large or too small. The author is then able to solve certain interpolation problems in the Banach algebra B of boun bounded analytic functions in the open unit disc. If $\{b_\nu\}$ and $\{c_\nu\}$ are 2 sequences with no common terms such that the corresponding Blaschke products $B(z)$ and $C(z)$ converge, it is shown that the condition $|B(z)| + |C(z)| \geq \delta > 0$ is necessary and sufficient for the existence of f in B such that $f(b_\nu) = 0$, $f(c_\nu) = 1$ $(\nu = 1, 2, \ldots)$. Finally the author solves an interpolation problem of D. J. Newman's to be equivalent to the corona conjecture. Thus the Corona problem is solved. The Corona conjecture is as follows. Given $f_1, \ldots, f_n$ in B, a necessary and sufficient condition for the ideal generated by them to be B is that there

exist $\delta > 0$ such that $|f_1(z)| + \ldots + |f_n(z)| > \delta(|z| < 1)$. (Math. Rev. abstract)

3115

Uppsala U. Inst. of Physical Chemistry (Sweden).

RESEARCH ON REACTIONS BETWEEN EXCITED MOLECULES AND MOLECULAR FRAGMENTS, by S. Claesson. Annual summary rept. no. 3. Mar. 1, 1960 - Feb. 28, 1961. Mar. 29, 1961. [9]p. (Supplemental agreement no. 2) (AFOSR 1319) (AF 61(052)70) AD 419223 Unclassified

For abstract see item no. 2980, Vol. V.

3116

Uppsala U. Inst. of Physics (Sweden).

A MAGNETIC SPECTROMETER FOR NEUTRON CAPTURE EXPERIMENTS, by G. Backstrom, A. Backlin and others. [1962] [15]p. incl. illus. diagrs. (AFOSR-4416) (AF EOAR-62-72) AD 295941 Unclassified

Also published in Nuclear Instr. and Methods, v. 16: 199-213, July 1962.

A 50 cm radius double focussing spectrometer is described, which is used for measuring internal conversion spectra following neutron capture. A collimated neutron beam interacts with a target inside the spectrometer. A target area of 20 cm^2 may be used at a line half-width of 0.1% due to a special arrangement involving electrostatic acceleration. The magnetic field is regulated to a few parts in 10^5, and data are taken automatically. Preliminary results are shown. The instrument may also be used for gamma-ray experiments, with either Compton electrons or photo-electrons. (Contractor's abstract)

3117

Uppsala U. Inst. of Physics (Sweden).

NOTE ON MOMENT ANALYSIS OF DELAYED COINCIDENCE EXPERIMENTS, by T. Sundström. [1962] [4]p. incl. diagr. (AFOSR-4417) (AF EOAR-62-72) AD 295942 Unclassified

Also published in Nuclear Instr. and Methods, v. 16: 153-156, July 1962.

The methods for moment analysis of delayed coincidence experiments are discussed, and the statistical error which affects the result is investigated. When the measured coincidence corresponds to a decay which is not purely exponential, moment analysis can be utilized for determination of the decay function. (Contractor's abstract)

3118

Uppsala U. Inst. of Physics (Sweden).

DELAYED COINCIDENCE MEASUREMENT OF THE LIFETIME OF THE 129-KEV LEVEL IN Ir 191, by J. Lindskog, T. Sundstrom, and P. Sparrman. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-4418) (AF AFOSR-62-72) AD 295944 Unclassified

Also published in Zeitschr. Phys. v. 170: 347-354, Nov. 1962.

The lifetime of the 129-kev level in Ir^{191} has been measured by the delayed coincidence technique.

The halflife was found to be $(13{\cdot}1 \pm 1{\cdot}0) \cdot 10^{-11}$ sec. This value is compared with the result of the measurements of the level width by Mössbauer experiments. The properties of the 2 first excited states in Ir^{191} and Ir^{193} are discussed.

3119

Uppsala U. Inst. of Physics (Sweden).

SINGLE AND DOUBLE INTERNAL BREMSSTRAHLUNG, by J. E. Thun, W. D. Hamilton and others. Sept. 13, 1963. [13]p. incl. diagrs. refs. (AFOSR-4419) (AF EOAR-62-72) AD 295943 Unclassified

Also published in Arkiv Fysik, v. 22: 565-577, 1962.

A theoretical calculation on internal bremsstrahlung is presented which gives the same result as that obtained from the theory of Knipp and Uhlenbeck. The IB cross section is measured for P^{32} by recording coincidences between β-particles of a certain energy selected by a magnetic spectrometer and IB photons above 300 kev. The angle between the β-particles and photons was 90°. The experimental result agrees well with theory. In connection with another experiment on double (2-quantum) internal bremsstrahlung (DIB), a theoretical calculation on this process is presented. The experiment in which triple coincidences between the β-particle and the related 2 photons are recorded puts an upper limit to the DIB from P^{32}. An upper limit to the rate of emission of nuclear γ-rays in this decay is also obtained from the experimental data. Finally, improvements of the experimental facilities are discussed which will further reduce the upper limit on DIB. (Contractor's abstract)

3120

Uppsala U. Inst. of Physics (Sweden).

INTERNAL CONVERSION COEFFICIENTS OF THE TRANSITIONS IN Tm^{169}, by Z. Grabowski, J. E. Thun, and B. Lindstrom. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-4420) (AF AFOSR-62-72) AD 295945 Unclassified

Also published in Zeitsch. Phy., v. 160: 303-314, Aug. 1962.

The conversion electron spectrum of Tm^{169} has been measured by an iron-yoke double focusing spectrometer. γ-Ray energies and γ-ray intensities were measured by a bent crystal spectrometer. Conversion coefficients and conversion ratios were determined from the electron and γ-intensities. The conversion process of the retarded M1 transitions of 177 kev and 198 kev was found to be normal, in agreement with earlier directional correlation results. No penetration effects were found in the conversion process of the retarded 63 kev E1 transition. (contractor's abstract)

3121

Uppsala U. Inst. of Physics (Sweden).

DOUBLE INTERNAL CONVERSION, by G. Bäckström, J. Lindskog, and J. O. Lindström. [1962] [2]p. incl. diagrs. [AF EOAR-62-72] Unclassified

Also published in Phys. Ltrs. v. 3: 23-24, Nov. 15, 1962.

The purpose of this paper is to report on the direct observation of this double conversion process for the 192 keV isomeric transition in In^{144}. Strong evidence for assuming that the effect observed is due to a nuclear 2 quantum process has been found. It is concluded that the electron coincidences observed are due to transitions via virtual nuclear states with a rate of 3×10^{-4} two step transitions (involving a K and an L electron) per direct transition.

3122

Uppsala U. Inst. of Physics (Sweden).

EXPERIMENTAL STUDIES OF THE ELECTROMAGNETIC TRANSITIONS FROM THE FIRST EXCITED STATES IN Hf^{177}, Lu^{175}, and Lu^{177} by J. Lindskog, T. Sundström, and P. Sparrman. [1962] [14]p. incl. diagrs. tables, refs. (AFOSR-J141) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-62-123] and Swedish Atomic Research Council) AD 400381 Unclassified

Also published in Arkiv Fysik, v. 23: 341-353, 1962.

The lifetimes of the first excited states of Hf^{177}, Lu^{175}, and Lu^{177} were measured by the delayed coincidence technique. The results of the measurements are given. In Lu^{177} the energies of the transitions from first and second excited states to the ground state were remeasured and the $L_I + L_{II}/L_{III}$ ratio for the 122 kev transition was determined. The properties of the 3 transitions treated are discussed in terms of the unified model. The possibility that the conversion coefficient for the 113 kev transition in Hf^{177} is affected by nuclear structure effects is considered. (Contractor's abstract)

3123

Uppsala U. Inst. of Physics (Sweden).

SEARCH FOR TWO-QUANTUM DECAY OF In^{114m}, by Z. Grabowski, S. Gustafsson, and G. Bäckström. [1962] [6]p. incl. diagrs. refs. (AFOSR-J316) (AF EOAR-62-123) AD 408027 Unclassified

Also published in Nuclear Phys., v. 38: 646-653, Nov. 1962.

The 192 kev isomeric state in In^{114} decays with a half-life of 50 d. Measurements of the K/L ratio with a double focusing spectrometer confirmed that the transition to the ground state is of E4 character. The level might alternatively decay by 2-quantum emission, which should be particularly probable in this case, since it may proceed by enhanced E2 transitions. Considering that the 192 kev E4 transition is strongly retarded, the In^{114m} case seems to be especially suitable for detection of 2-quantum decay. This mode of decay was experimentally investigated by coincidence measurements between gamma rays of 96 kev and other gamma-rays, didplayed on a multi-channel analyzer. The result shows that the relative probability for 2-quantum decay is less than 3×10^{-5}, a value which is orders of magnitude lower than theoretical estimates. Analogous experiments with conversion electrons might prove valuable.

3124

Uppsala U. Inst. for Physics (Sweden).

NUCLEAR g-FACTOR OF THE 113 KEV ROTATIONAL STATE IN THE ODD A NUCLEUS Hf^{177}, by E. Matthias, E. Karlsson, and C.-A. Lerjefors. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-J778) (AF EOAR-62-123) AD 411236 Unclassified

Also published in Arkiv Fysik, 22: 139-146, 1962.

The shift of the 208 kev-113 kev angular correlation in Hf^{177} has been measured in external magnetic fields of 53,100 gauss and 29,200 gauss. The result is

$$\frac{W_L \tau N}{|B|} \quad \text{or} \quad W_L \tau N' \cdot |B'| = (0.824 \pm 0.025)$$

$\times 10^{-6}$ rad/ gauss. With a halflife of (0.52 ± 0.02) nsec for the 113 kev state this leads to the g-factor $g = 0.232 \pm 0.013$. An investigation of the internal perturbation by varying the viscosity of the source yields that the perturbation, if present, is smaller than 2%. The result is discussed in terms of the unified model. (Contractor's abstract)

3125

Uppsala U. Inst. of Physics (Sweden).

MAGNETIC DIPOLE INTERACTION STUDIED BY THE DIFFERENTIAL ANGULAR CORRELATION METHOD, by E. Matthias, L. Bostrom and others. [1962] [14]p. incl. diagrs. tables. refs. (AFOSR 64-0657) (AF EOAR-62-123) AD 435923 Unclassified

Also published in Nuclear Phys., v. 40: 656-669, Feb. 1963.

An apparatus for the investigation of differential angular correlations between 2 gamma rays is described. The principles of g-factor measurements with the differe tial method are analyzed, taking into account the influence of the finite resolving time of the time-to-pulse-height converter and the influence of time-dependent perturbations. (Contractor's abstract)

3126

Uppsala U. Inst. of Physics (Sweden).

AUGER SPECTRA IN THE INTERMEDIATE COUPLING REGION, by O. Hornfeldt, A. Fahlman, and C. Nordling. [1962] [9]p. incl. diagrs. tables, refs. [AF EOAR 62-123] Unclassified

Published in Arkiv Fysik, v. 23: 155-163, 1963.

K-LL Auger spectra of the elements from strontium (Z = 38) to silver (Z = 47) have been studied with a high-resolution β-spectrometer. The 9-line spectrum predicted in the intermediate coupling theory has been established in strontium, zirconium, and molybdenum. Energies and relative intensities have been measured. From the observed separations of the lines in the strontium, zirconium, and molybdenum spectra a set of constant is obtained for the calculation of K-LL Auger energies in the intermediate coupling region. These constants differ considerably from those given by Asaad and Burhop, which indicates that for a given set of constants, the corresponding expressions for the calculation of Auger energies are valid only over a restricted Z region. (Contractor's abstract)

3127

Uppsala U. [Inst. of Physics] (Sweden).

GAMMA-GAMMA ANGULAR CORRELATION AND INTENSITY MEASUREMENTS ON LOW ENERGY GAMMA RAYS IN THE DECAY OF Ce^{144}, by W. Zuk and S. Gustafsson. [1962] [9]p. incl. diagrs. table, refs. [AF EOAR-62-123] Unclassified

Published in Arkiv Fysik, v. 24: 69-77, 1963.

The decay of Ce^{144} has been investigated using a γ-scintillation spectrometer and an automatic γ-γ directional correlation apparatus. The relative intensities of the following γ-rays of Pr^{144}, 134 and 80 kev, and the 36 kev x-ray have been measured giving the following result 100; 33.4 ± 1.0; 107.0 ± 2.0. The result for the 80 kev γ-ray is in agreement with Hickok et al, and in disagreement with Geiger et al. A measurement has been made of the γ-γ angular correlation of the 54-80 kev cascade in Pr^{144}. This measurement confirms the 1⁻ spin assignment of Geiger et al for the 134 kev level. In Nd^{144}, the angular correlation of the 1.49-0.69 mev cascade has been measured. The result is in very good agreement with the previous measurement by Steffen. (Contractor's abstract)

3128

Uppsala U. Inst. for Physics (Sweden).

THE GYROMAGNETIC RATIO OF THE FIRST ROTATIONAL STATE IN Hf^{178}, by E. Karlsson, E. Matthias, and S. Ogaza. [1962] [10]p. incl. diagrs. tables, refs. [AF EOAR-62-123] Unclassified

Published in Arkiv Fysik, v. 22: 257-266, 1962

The g-factor of the 93 kev state in Hf^{178} has been measured by observation of the shift of the angular correlation in external magnetic fields of 45,760 and 25,200 gauss. The result was g = + 0.29 ± 0.02. A time-dependent electric quadrupole perturbation was found in the source used by means of an attenuation measurement. The corresponding integral factors G_2 = 0.74 ± 0.09 and G_4 = 0.818 ± 0.046 were used for corrections to the $w\tau$-value. The life-time of the 93 kev state was found to be τ = 2.16 ± 0.04 ns. The result is in agreement with the theoretical predictions of Nilsson and Prior. (Contractor's abstract)

3129

[Uppsala U. Inst. for Physics (Sweden)]

AN INSTRUMENT FOR THE STUDY OF MOMENTS OF EXCITED NUCLEAR STATES BY ANGULAR CORRELATION METHODS. PART A: PRINCIPLES OF MEASUREMENTS WITH A 4-DETECTOR SYSTEM AND APPLIED EXTERNAL FIELDS. CONSTRUCTION OF A NEW 60,000 GAUSS ELECTROMAGNET BASED ON THESE PRINCIPLES, by B. E. Karlsson [1962] 25p. incl. illus. diagrs. tables, refs. [AF EOAR-62-123] Unclassified

Published in Arkiv Fysik, v. 22: 1-25, 1962.

Methods for measuring small perturbations in γ-ray angular correlations with good accuracy are presented.

The sensitivity of the measurements is increased by using a multi-detector system. It is shown that the inherent symmetry properties of a 4-detector system can be utilized for reduction of systemic errors. A 60,000 gauss electromagnet was constructed especially for this application and possibilities of applying magnetic fields both parallel and perpendicular to the detected radiations add to the flexibility of the arrangement. In connection with each particular application, possible experiments are outlined. In part B of this paper, the electronic system is presented as well as a summary of results obtained.

3130

[Uppsala U. Inst. for Physics (Sweden)]

AN INSTRUMENT FOR THE STUDY OF MOMENTS OF EXCITED NUCLEAR STATES BY ANGULAR CORRELATION METHODS. PART B: ELECTRONIC EQUIPMENT. TEST METHODS AND PERFORMANCE OF THE SYSTEM, by B. E. Karlsson, E. Matthias, and C-A. Lerjefors. [1962] [13]p. incl. diagrs. tables, refs. [AF EOAR-62-123] Unclassified

Published in Arkiv Fysik, v. 22: 27-39, 1962.

In item no. 3129 accurate methods for measuring small perturbations in γ-ray angular correlations were presented. Here, some features of a detecting system especially made for this purpose will be discussed. Four detectors are used, and information from these is collected in several coincidence circuits simultaneously. The operation of the detectors in the vicinity of strong magnetic fields is also of great interest. A summary is given of results obtained.

3131

Uppsala U. Inst. of Physics (Sweden).

ON THE TRANSITIONS FROM THE EXCITED LEVELS OF Re^{187}, by K. S. Han, S. C. Pancholi, and Y. Grunditz. [1962] [9]p. incl. diagrs. tables, refs. [AF EOAR 62-123] Unclassified

Published in Arkiv Fysik, v. 23: 505-513, 1963.

The internal conversion spectrum from the excited levels of Re^{187} has been studied by means of a high resolution double focusing magnetic β-ray spectrometer. A total of 34 internal conversion lines and 6 Auger lines were found. The energies of the 14 observed γ transitions are in excellent agreement with those of previous work. Multipolarity assignments for the γ-transitions have been made on the basis of internal conversion coefficient radios. (Contractor's abstract)

3132

Uppsala U. Inst. of Physics (Sweden).

PHOTO ELECTRON MEASUREMENTS OF L LEVELS IN THE ELEMENTS STRONTIUM (Z = 38) TO PALLADIUM (Z = 46), by A. Fahlman, O. Hornfeldt, and C. Nordling. [1962] [6]p. incl. diagrs. tables, refs. [AF EOAR-62-123] Unclassified

Published in Arkiv Fysik, v. 23: 75-80, 1963.

The photo electron method has been applied for precision measurements of the L_I, L_{II} and L_{III} binding energies in the elements strontium (Z = 38) to palladium (Z = 46). For technetium (Z = 43), no experimental determinations of the electron binding energies have previously been reported. Good agreement is found with theoretical predictions for spin and screening doublet splittings, whereas a comparison with x-ray data shows discrepancies that are significant. (Contractor's abstract)

3133

[Uppsala U. Inst. of Physics (Sweden)]

THE PHOTO ELECTRON METHOD OF DETERMINING h/e, by S. Hagström, O. Hörnfeldt and others. [1962] [9]p. incl. diagrs. refs. [AF EOAR-62-123] Unclassified

Published in Arkiv Fysik, v. 23: 145-153, 1963.

A new method has been applied for the determination of the fundamental constant combination h/e. Photo electrons from the same shell in a converter material are expelled by the characteristic x-radiation ($K\alpha_1$) from 2 different elements. The electron lines are brought to a common focus in a high precision iron-free β-spectrometer by accelerating or retarding the photo electrons. Equating the total applied voltage times the electronic charge, Ve, to the energy difference between the two x-ray lines, $h(\nu_1 - \nu_2)$, gives h/e. Some preliminary measurements are reported together with a study of possible systematic errors. The measurements give for the quantum energy conversion constant ($E\lambda_s$), ($E\lambda_s$) (12372.9 ± 1.5)kv · X.U. from which (4.1356 ± 0.0006) x 10^{-15} J/A is obtained for the ratio h/e.

3134

Uppsala U. Inst. of Physics (Sweden).

THE Z-DEPENDENCE OF ENERGIES AND RELATIVE INTENSITIES IN THE K-LL AUGER SPECTRUM, by O. Hörnfeldt. [1962] [11]p. incl. diagrs. tables, refs. [AF EOAR-62-123] Unclassified

Published in Arkiv Fysik, v. 23: 235-245, 1963.

The formulae deduced by Asaad and Burhop for calculating K-LL Auger energies have been adjusted to experimental data by introducing a new expression to approximate the electrostatic interaction energy between the 2 vacancies in the final state of the atom. Using the modified formulae, the K-LL Auger energies have been calculated for 81 elements, the Z-values ranging from Z = 20 to Z = 100. In most cases, the agreement with observed energies is better than 0 05% or within the errors of the measurements. Using published experimental data, the intensities of the lines in the K-LL spectrum relative to that of the K-L_1L_1 ($^1S_0$) transition have with one exception (the K-L_1L_2 transitions) been demonstrated to be linearly dependent on Z or Z^{-2}. This empirically obtained Z-dependence is different from the theoretical predictions by Asaad and Burhop, and by Callan. (Contractor's abstract)

3135

Utah U. Dept. of Chemical Engineering, Salt Lake City.

IGNITION AND COMBUSTION OF SOLID PROPELLANTS, by R. C. Mitchell and J. A. Keller. Oct. 1, 1961 to Sept. 30, 1962, 35p. incl. diagrs. tables, refs. (AFOSR-5316) (AF AFOSR-62-99)
Unclassified

The response of several selected composite propellants subjected to surface heat fluxes was experimentally studied. The surface propellant samples were subjected to thermal-radiation heat fluxes from 1 to 13.5 cal/sec sq cm and convective heat fluxes from 30 to 100 cal/sec sq cm. Parallel theoretical studies, which were guided by the experimental results, have given a satisfactory explanation of the general character of the ignition process. The scope of this research work has been broadened to include several phases of the combustion of solid propellants.

3136

Utah U. Dept. of Chemical Engineering, Salt Lake City.

COMBUSTION IRREGULARITIES IN SOLID PROPELLANTS, by R. L. Coates. Fifth quarterly progress rept. Apr. 1-June 30, 1962. Aug. 6, 1962 [111]p. incl. diagrs. tables, refs. (AF AFOSR-62-451) AD 284930 Unclassified

The results of all firings to date are presented in graphical form, together with some analysis of energy losses. Tables of firing data are included, and the analysis to relate viscoelastic properties to the propellant response behavior is extended. Further efforts to measure viscoelastic properties are also described. The estimation of the acoustic admittance of the burning surface and of the gas phase attenuation constant from growth and decay constants is discussed. The specific acoustic admittance ratio of the surface, referred to as the gas phase, is estimated to be of the order 0.01 to 0.03, decreasing in magnitude in the frequency range 1 to 6 kc. (Contractor's abstract)

3137

Utah U. [Dept. of Metallurgy] Salt Lake City.

IONIZATION IN THE SHOCK INITIATION OF DETONATION, by A. Bauer, M. A. Cook, and R. T. Keyes. Sept. 15, 1962 [30]p. incl. illus. diagrs. tables, refs. (AFOSR-4053) (AF 18(603)100) AD 289569
Unclassified

Conduction-time (or distance) curves measured by both the "parallel" and "perpendicular probe" methods in receptors of the "card gap", "shock pass, heat filter plate" and plate impact methods of sensitivity are correlated and compared with the pressure-time (or distance) curves obtained by the aquarium method. Results indicate that detonation is initiated by a shock-wave only upon establishment of (dilute) plasma conditions in the shock front. The ionization wave that establishes this coincidence is initiated at the inert barrier or SPHF plate after a time τ following transmission of the shock into the receptor. After formation, requiring a finite time, the ionization wave builds up in intensity at the SPHF plate, flashes forward into the receptor charge and apparently triggers detonation (at the instant of arrival of a critical level of ionization) at the shock front. Therefore, the pressure in the shock front, while an important factor in the shock initiation of detonation, may not be the only, or even the most important one; strong ionization may also be an essential factor. Shock initiation of detonation appears to require the development of a strongly ionized reaction shock. (Contractor's abstract)

3138

Utah U. Dept. of Metallurgy, Salt Lake City.

CHEMICAL REACTION RATES AND THE SHOCK INITIATION OF DETONATION IN LIQUID EXPLOSIVES, by A. Bauer, M. A. Cook, and R. T. Keyes. Sept. 3, 1962 [21]p. incl. illus. diagrs. tables, refs. (AFOSR-4054) (AF 18(603)100) AD 287915
Unclassified

Detonation velocity-charge diameter curves were obtained for the liquid explosives, nitromethane, dithekite-13, D-8, 97.2/2.8 NM-ethylene diamine, 80/20 NM-tetryl, and 80/20 NM-TNT. A point initiation model for liquid explosives, according to which the chemical reaction was assumed to start at small centers and proceed radically outward, was developed and applied with the detonation head model to determine chemical reaction times for NM and D-13. The shape of the velocity-diameter curves and the manner in which they were fit by the calculations indicated that indeed detonation reactions in liquid explosives expand outward from small centers of initiation. Preliminary measurements of the pressure associated with the super velocity of "flash-across" phenomenon observed in the shock

initiation of liquid explosives are also presented. The measurements were made to determine if this phenomenon which propagates from the barrier-receptor interface to the initial shock front during the card gap tests at velocities that exceed the normal detonation velocity, is governed by hydrodynamic laws of wave propagation. (Contractor's Abstract)

3139

Utah U. Dept. of Metallurgy, Salt Lake City.

ELECTRICAL AND PLASMA PHENOMENA ACCOMPANYING DETONATION, by M. A. Cook and R. T. Keyes. Final rept. Oct. 1, 1961-Sept. 30, 1962 [20]p. incl. diagrs. (AFOSR-4052) (AF 49(638)1061) AD 289568 Unclassified

The investigation carried out fall under the following general classifications: (1) ionization and electrical conductivity and its relationship to the deflagration to detonation transition in solid explosives, (2) chemical reaction rates and the shock initiation of detonation of liquid explosives, (3) mechanism of the "flash-across" phenomenon in the card-gap test for liquid explosives, and (4) spectrographic studies of external detonation-generated plasmas.

3140

Utah U. Dept. of Physics, Salt Lake City.

THE INTERACTION OF LIGHT WITH MATTER STUDIES BY THE EFFECT OF DIFFRACTION ON POLARIZATION, by F. S. Harris, Jr. Final rept. Jan. 27, 1962. 2p. (AFOSR-2122) (AF 49(638)799) Unclassified

Studies were made of Fresnel diffraction by a slit for small angles; also there were made studies of diffraction at wide angles with measurements of intensity in polarization. Detailed calculations with a computer have been made of diffraction by a half plane with regard to Sommerfield theory. The incident plane of polarization, the material of the edge and the wave length of the light were found to have a marked effect on the diffraction pattern. Edges of optical quality and the difficulty of measuring with extreme sensitivity proved to be limiting factors. A photometer was developed for measuring very small light intensities as a function of the diffraction.

3141

Utah U. [Dept. of Physics] Salt Lake City.

DIFFRACTION OF POLARIZED LIGHT AT WIDE ANGLES IN THE SHADOW OF A HALF-PLANE (Abstract), by F. S. Harris, Jr., M. S. Tavenner, and G. R. Orme. [1961] [2]p. [AF 49(638)799] Unclassified

Presented at Spring meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 2-4, 1961.

Published in Jour. Opt. Soc. Amer., v. 51: 477-478, Apr. 1961.

Wide-angle diffraction patterns in the shadow of a half-plane were measured over a range of 10^8 in relative intensity. Patterns studied included light unpolarized, polarized parallel to edge, and perpendicular to diffracting edge. Light of wavelength 5461 A was measured 19 cm from the edge by means of a scanning dry-ice cooled 1P21 photomultiplier photometer whose output was traced on a strip-chart recorder. This system was adapted from one previously used for long-light-path studies. With a 90° normal-incident light on the half-plane, the diffracted light was measured from 9° to 56° diffracting angle. At 56°, intensities of 2.52×10^{-8} for parallel-polarized and 4.29×10^{-8} for perpendicular-polarized light were measured. These experimental results are in general less than Sommerfeld theory curves. The ratio of perpendicular to parallel intensities increased to a value of about 2 at a diffracting angle of 40°, decreasing for larger angles. This was much less than Sommerfeld's theoretical values. Unpolarized light intensity values were along the Sommerfeld parallel-polarization curve.

3142

Utah U. [Dept. of Physics] Salt Lake City.

EXPERIMENTAL MEASUREMENTS OF WIDE-ANGLE DIFFRACTION BY A BLACK HALF-PLANE (Abstract), by F. S. Harris, Jr., D. B. Brownell, Jr., and W. T. Silfvast. [1962] [1]p. [AF 49(638)799]

Presented at Annual meeting of the Opt. Soc. Amer., Rochester, N. Y. [1962].

Published in Jour. Opt. Soc. Amer., v. 52: 1324, Nov. 1962.

Measurements have been made of the effect of black-edge materials on the diffraction pattern at wide angles up to 60°. Using a sensitive liquid-nitrogen-cooled photometer, differences were found in edge effects due to various types of black surfaces on the polarization and intensity of the diffracted light. The results are compared with various black screen theories.

3143

Utah U. [Dept. of Physics] Salt Lake City.

EFFECT OF PRESSURE ON CREEP IN TIN, by K. L. DeVries, G. S. Baker, and P. Gibbs. [1962] [2]p. incl. diagrs. [AF 49(638)853] Unclassified

Published in Jour. Appl. Phys., v. 34: 2258-2259, Aug. 1963.

Bending creep of tin is reported with an activation volume of approximately 8.5 x 10^{-24} cm^3, essentially independent of temperature between 0° and 57°C, and pressures to 8 kbar. The pressure dependence of the output of resistance-type strain gauges is given.

3144

Utah U. [Dept. of Physics] Salt Lake City.

PRESSURE DEPENDENCE OF INTERNAL FRICTION OF ALUMINUM (Abstract), by J. L. Seely, G. S. Baker, and P. Gibbs. [1962] [1]p. [AF 49(638)353] Unclassified

Presented at meeting of the Amer. Phys. Soc., Baltimore, Md., Mar. 26-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 225, Mar. 26, 1962.

Internal-friction measurements were made as a function of hydrostatic pressures up to 3 kbar by use of a piezoelectric torsional oscillator inside the pressure vessel, as well as with a Marx composite oscillator both before and after pressure treatment. Specimens were prepared by coldworking 99.99% aluminum polycrystals to a 50% reduction in width, followed by an anneal at 300°C. Measurements outside the pressure vessel showed that the strain-amplitude dependence was irreversibly increased by amounts up to 1500% of the initial values as a result of the application of 3 kbar for 15 min at 25°C. The original amplitude dependence was restored by annealing 15 min at 300°C. A subsequent compression again increased the amplitude dependence, but to a lesser extent. After several such annealing-compression cycles there was no irreversible effect within 4% of background. Additional cold-work followed by annealing again produced the effect. The effect increased with increasing pressure. An increase in amplitude dependence of up to 600% also occurred in samples which had not been previously coldworked. The internal friction at constant strain amplitude increased faster than linearly with increasing pressure and decreased linearly with decreasing pressure. Successive pressure cycles gave the same effect but with decreasing magnitude.

3145

Utah U. [Dept. of Physics] Salt Lake City.

PRESSURE DEPENDENCE OF THE CREEP OF LEAD, by K. L. DeVries, G. S. Baker, and P. Gibbs. [1962] [4]p. incl. diagrs. refs. [AF 49(638)853] Unclassified

Published in Jour. Appl. Phys., v. 34: 2254-2257, Aug. 1963.

Apparatus is described for maintaining hydrostatic environment, 1 in. in diameter by 4 in. long, with 8 to 12 electrical leads, up to 20-kbar pressure and various temperatures. Bending creep of 99.999 + % lead is reported with an activation volume of about 21 x 10^{-24} cm^3, essentially independent of temperature between 0° and 57°C. Evidence for recrystallization is given. (Contractor's abstract)

3146

Vermont U. [Dept. of Physics] Burlington.

RESEARCH IN NONLINEAR SONIC PHENOMENA, by W. L. Nyborg. Final rept. Oct. 15, 1960-Oct. 14, 1962, 5p. (AFOSR-5202) (AF 49(638)968) AD 416602 Unclassified

A laboratory was developed for carrying out experiments with very intense sound in the high frequency range, from 200 kc to 10 mc, consisting of a 10 kilowatt transmitter. Controlled bubble production and activity in sound fields was studied. Work on vibrating gas-liquid interfaces and associated events showed that a spatially periodic eddying configuration is set up near the surface standing wave as predicted by Lanquet-Higgens. The magnitude is far more than expected which suggested the liquid air interface presents some sort of "skin" on which the oscillating liquid exerts tangential stress. Work was conducted concerning the design and testing of composit "Mason-horn" type transduces of brass, steel and stainless steel suitable for experiment where prescribed localilized vibration is applied. The unit operated at about 85 kc. Exploratory work showed that when a unit is used as an electrode during electrolysis, considerable variation in the process is observed when vibration is applied.

3147

Vienna U. Inst. for Theoretical Physics (Austria).

TWO-PION FORCE AND THREE-PION SYSTEM, by G. Eder. Jan. 10, 1962 [10]p. incl. diagr. tables, refs. (Scientific note no. 13) (AFOSR-2693) (AF 61(052)265) AD 280985 Unclassified

Also published in Nuclear Phys., v. 37: 85-89, Aug. 1962.

A δ-type π-π potential is used to describe the π-π scattering up to the ζ-resonance. By this potential a 3-pion system is investigated for a state of $J = 1$ and $I = 0$. It seems possible to understand either the η- or the ω-particle as metastable states of such a system. (Contractor's abstract)

3148

Vienna U. Inst. for Theoretical Physics (Austria).

THE PRESENT STATUS OF THE NEW RESONANCES, by A. P. Balachandran and H. Pietschmann. May 30, 1962, 28p. incl. tables, refs. (Scientific note no. 14) (AFOSR-2978) (AF 61(052)265) AD 278179 Unclassified

The available experimental material on the resonances observed in systems of strongly interacting particles is presented. The report confines itself strictly to well-established facts and although references to the various phenomenological models proposed to understand these resonances are given, none of the conclusions reached purely from such models are included in the tables for these resonances.

3149

Vienna U. Inst. for Theoretical Physics (Austria).

ON A POSSIBLE $\Xi\pi$ RESONANCE, by A. P. Balachandran and H. Pietschmann. June 30, 1962, 4p. (Scientific note no. 15) (AFOSR-3100) (AF 61(052)265) AD 289427 Unclassified

Also published in Physics Ltrs. v. 2: 126-127, Sept. 1, 1962.

The possibility of a $T = 1/2$, $D_{3/2}$ resonance in the Ξ - π system is pointed out by a consideration of the octet model for strong interactions. For this purpose, the resonances Y_1^*, N^{**} and Y_0^{**} are classified into the same octet, assuming tentatively that Y_1^* is a $D_{3/2}$ resonance. A Ξ-π resonance appears to have the perdicted quantum numbers reported at the 1962 CERN conference. Following the method of Gell-Mann, the authors predict $T = 1/2$ in the Ξ - π system with a mass about 1460 mev. Experiments in which it can show up are discussed.

3150

Vienna U. Inst. for Theoretical Physics (Austria).

QUANTUM THEORY OF TRANSPORT COEFFICIENTS. I, by K. Baumann and J. Ranninger. [1962] [14]p. incl. diagrs. [AF 61(052)265] Unclassified

Published in Ann. Phys., v. 20: 157-170, Nov. 1962.

The techniques of modern quantum field theory are applied to the electron-hole field interacting with the field of phonons in a crystal. The interaction is described by the Fröhlich Hamiltonian. In the evaluation of the electrical conductivity, an infinite number of Feynman diagrams has to be taken into account. The first 3 of these diagrams are worked out explicitly, and are found to be the beginning of a geometrical series, which yields a conductivity $\sim T^{-4}$ for $T/\theta << k\theta/E_F$, $\sim T^{-5}$ for $k\theta/E_F << T\ \theta << 1$. For $T/\theta >> 1$ the well-known T^{-1} law is reproduced. (Contractor's abstract)

3151

Vienna U. Inst. for Theoretical Physics (Austria).

QUANTUM THEORY OF TRANSPORT COEFFICIENTS. II, by K. Baumann. [1962] [12]p. incl. diagrs. [AF 61(052)265] Unclassified

Published in Ann. Phys., v. 23: 221-232, Aug. 1963.

The method of thermal Green's functions is applied to a lowest order calculation of different transport coefficients. This is the first step of a systematic approach intended to replace the use of the Boltzmann equation. (Contractor's abstract)

3152

Vienna U. Inst. for Theoretical Physics (Austria.

SYMMETRIES OF FUNDAMENTAL PARTICLE INTERACTIONS, by W. E. Thirring. Final rept. Aug. 31, 1962. 7p. (AFOSR-3761) (AF 61(052)265) AD 289250 Unclassified

The 15 scientific notes abstracted in this report are summarized as being a first attempt to calculate quantities like the pion-nucleon coupling constant. These results do not contradict the speculation that the weak interactions are responsible for binding nucleons and antinucleons together and thereby generating strong interactions. Some special dynamical problems were studied by the whole group. Finally, some research has been carried out in connection with the recently discovered resonances.

3153

Vienna U. Inst. for Theoretical Physics (Austria).

ELASTIC SCATTERING OF HIGH ENERGY PROTON ON HYDROGEN NUCLEI, by G. Czapek, G. Kellner and others. Jan. 12, 1962, 4p. incl. diagrs. (Scientific note no. 2) (AFOSR-2177) (In cooperation with Bern U., Switzerland) (AF 61(052)433) AD 271651 Unclassified

Also published in Aix-en-Provence Internat'l. Conf. on Elementary Particles; Proc.; Aix (France) (Sept. 14-20, 1961), ed. by E. Cremieu-Alcan, P. Falk-Vairant, and O. Lebey. Gif-sur-Yvette, C.E.N. Saclay, v. 1: 111-115, 1961.

Experimental results from 480 elastic scatterings of 24.5 (bev c)-protons on hydrogen nuclei with laboratory-scattering angles above 2 mrad are presented. The work is still going on in order to improve these statistics. Two different and complementary methods were applied. (Contractor's abstract)

3154

Vienna U. Inst. for Theoretical Physics (Austria).

ELASTIC PROTON-PROTON SCATTERING AT HIGH ENERGIES, by G. Czapek, G. Kellner, and G. Otter. Apr 2, 1962 [23]p. incl. diagrs. table, refs. (Scientific note no. 3) (AFOSR-2691) (AF 61(052)433) Unclassified

Elastic p-p scattering at 23.5 gev kinetic energy has been studied in nuclear emulsions. The emulsions were exposed normally to their plane to the external proton beam of the CERN PS. 133 proton-free-proton elastic scatterings have been found. The contribution of quasielastic events and other background is about 4%. The elastic cross section gives $\sigma_1 = (8.3 \pm \frac{1.2}{0.7})$ mb. The behavior of the differential cross section shows that the real part of the scattering amplitude must be assumed to be small. The elastic scattering at high energies has been calculated with the simple model of a completely absorbing target nucleon. The following assumptions have been made: (1) there is a well defined surface of the nucleon with radius R and (2) a large number of reaction channels is open for the incoming particle. Numerical evaluation of the result shows close agreement with the experimental data for R = 1.10 fermi. (Contractor's abstract)

3155

Vienna U. Inst. of Theoretical Physics (Austria)

DETERMINATION OF THE SLOPE OF THE POMERANCHUK-TRAJECTORY FROM HIGH ENERGY ELASTIC SCATTERING, by G. Czapek, G. Kellner and H. Pietschmann. May 14, 1962, [9]p. incl. diagrs. tables, refs. (Scientific note no. 4) (AFOSR-2977) (AF 61(052)433) AD 283659 Unclassified

New light has been shed on the theory of elementary particles by the hypothesis, that the concept of singularities in the complex angular momentum variable (Regge-poles) also applies to a relativistic quantized theory. In particular, the assumption is made that particles (including resonances) which differ only by their mass and spin values lie on the same trajectory in the Chew-Frautschi diagram. On the other hand, high energy elastic scattering is correlated to the slope of the Pomeranchuk trajectory. It is mentioned that a high energy behavior of this type is also a consequence of a model in the strip approximation to the Mandelstam representation. Furthermore, this model provides successive approximations to the form factor of the diffraction scattering amplitude. As a consequence of the Regge-type behavior, the differential elastic cross-section at high energies should decrease exponentially from the optical point

$$\frac{d\sigma}{d\Omega} \sim e^{-2t\, t_0(s)}$$

This is verified by plotted results and is used to establish the slope of the Pomeranchuck-trajectory expanding it into a power series. The elastic scattering of 16 GEV π-mesons and GEV protons on protons has been studied with bubble chamber and emulsion techniques. The hypothesis of Regge-poles though not on very good footing from a theoretical point of view seems to be very appealing when compared with the experiment.

3156

Virginia U. Dept. of Mathematics, Charlottesville.

THE CAUCHY INEQUALITY IN TOPOLOGICAL ANALYSIS, by G. T. Whyburn. [1962] [2]p. (AFOSR-3240) [AF 49(638)72] Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 1335-1336, Aug. 1962.

In this paper, it is shown how an auxiliary function used by Read may be fitted into a lemma of Connell and Procelli to obtain the Cauchy inequality at an early stage of the development of analytic function theory by toological methods. This then may be used in the same context to obtain directly and initially the standard Taylor series development with full radius of convergence.

3157

Virginia U. Research Labs. for the Engineering Sciences, Charlottesville.

AN ELECTROMAGNETIC SUSPENSION SYSTEM FOR THE MEASUREMENT OF AERODYNAMIC CHARACTERISTICS, by H. M. Parker, J. E. May, and G. S. Nurre. Mar. 1962. [40]p. incl. illus. diagrs. refs. (Rept. no. AST-4433-106-62U) (AFOSR-2294) (AF 49(638)1022) AD 273655 Unclassified

The design concepts are presented for a free electromagnetic suspension system functioning as force balance yielding simultaneous and independent measurements of force in 3 mutually perpendicular directions. The system is adapted to function as a wind tunnel balance which requires no physical attachment to the model under study. The concepts have been reduced to practice in a first-generation balance which is to be applied to the study of low-density sphere drags as a first demonstration of the unique capabilities of this balance system. The first model also is intended to serve as a test device to provide design information for a second-generation balance for the study of dynamic stability. The apparatus is described in detail and calibration procedures and future applications are discussed. (Contractor's abstract)

3158

Vitro Corp. of America, Vitro Lab., Silver Spring, Md

SYMMETRIC VIBRATION OF THE ELASTIC SOLID CYLINDER, by D. S. Moseley. Mar. 22, 1962 - Dec. 14, 1962. [31]p. (Technical rept. no. TN 1734-01-1) (AFOSR-4650) (AF 49(638)1148) AD 407408 Unclassified

The exact formulation of displacements and resonant frequencies of an elastic solid cylinder was attempted. Progress was made, but the principal objective was not reached. This report traces the course of work through the early demonstration of invalidity of a formulation that was postulated prior to the contract, and through several assaults upon the problem. Novel solutions of the wave equation for radially symmetric displacements were discovered. A section is devoted to the recommended direction of future work.

3159

Wales U. Coll. Dept. of Agricultural Biochemistry, Aberystwyth.

THE INCORPORATION OF [2-^{14}C] MEVALONIC ACID AND $^{14}CO_2$ INTO THE PHYTYL SIDE CHAIN OF CHLOROPHYLL IN MAIZE SEEDLINGS, by E. I. Mercer and T. W. Goodwin. [1962] [1]p. (AFOSR-4343) (AF 61-(052)355) AD 404876 Unclassified

Presented at 419th meeting of the Biochem. Soc., Inst. of Rural Science, Penglais, Aberystwyth (Wales). Sept. 13-14, 1962.

Also published in Biochem. Jour., v. 85: 13P, Nov. 1962.

The relative incorporation of mevalonic-2-C^{14} acid and $C^{14}O_2$ into the phytyl side chain of chlorophyll was studied in corn seedlings during illumination. The mevalonic-2-C^{14}-treated corn yielded 5.2 mg of sterol with a specific activity of 84,530 counts min mg (total counts 440,330) and phytol containing a total of 400 counts min. The $C^{14}O_2$-treated corn yielded 5.7 mg of sterol with a specific activity of 15,860 counts min mg (total counts 90,400 min) and phytol containing a total of 114,000 counts min (specific activity 160,500 counts min mg.

3160

Wales U. Coll. Dept. of Agricultural Biochemistry, Aberystwyth.

STUDIES IN CAROTENOGENESIS. 29. ATTEMPTS TO DETECT LYCOPERSENE IN HIGHER PLANTS, by E. I. Mercer, B. H. Davies, and T. W. Goodwin. [1962] [9]p. incl. diagrs tables, refs. (AFOSR-J840) (AF 61-(052)355) AD 416554 Unclassified

Also published in Biochem. Jour., v. 87: 317-325, May 1963.

A method for the detection and identification of lycopersene has been developed. The sensitivity limit is 0.05 ug. Analysis of the unsaponifiable components of excised, etiolated maize seedlings exposed to [2-C^{14}]mevalonate under conditions of light and darkness, and to $C^{14}O_2$, has failed to reveal the presence of lycopersene. [C^{14}]Carbon dioxide is incorporated into both squalene and phytoene by maize seedlings, but [2-C^{14}]mevalonate is incorporated only into squalene. [2-C^{14}]Mevalonate is incorporated into both squalene and phytoene by carrot-root slices; no lycopersene could be detected. Tare (Vicia sativa) lipid was also examined for the presence of lycopersene, but none was detected. Lycopersene is probably not a precursor of carotenoids.

3161

Wales U. Coll. Dept. of Agricultural Biochemistry, Aberystwyth.

COUMARIN AND RELATED COMPOUNDS IN ANTHOXANTHUM AND MELILOTUS SPECIES, AND THE FORMATION OF DICOUMAROL, by W. M. Ashton and E. G. Davies. [1962] [2]p. [AF 61(052)355] Unclassified

Presented at 419th meeting of the Biochem. Soc., Inst. of Rural Science, Penglais, Aberystwyth (Wales), Sept. 13-14, 1962

Published in Biochem. Jour., v. 85: 22P, Nov. 1962.

Both Anthoxanthum odoratium (sweet vernal grass) and Melilotus alba (sweet clover) contain melilotic, o-coumaric and p-coumaric acids, and esculin the former contains ferulic acid, the latter, 7-hydroxycoumarin. With spoilage of anthoxanthum hay, coumarin disappeared in 18 days, the amount of related compounds increased and reached a steady maximum in 4 weeks. Dicoumarol (I) was detected chromatographically in the spoiled hay. Additions of penicillium jensenl to anthoxanthum or sweet-clover hay increased the I formed, and the amount of available formaldehyde appeared to limit I production. o-Coumaric acid and not coumarin is considered to be the percursor of 4-hydroxycoumarin and hence I.

3162

Wales U. Coll. Dept. of Agricultural Biochemistry, Aberystwyth.

PRELIMINARY OBSERVATIONS ON TERPENOIDS IN PLANT TISSUE CULTURES, by T. W. Goodwin and B. L. Williams. [1962] [1]p. [AF 61(052)355] Unclassified

Presented at 419th meeting of the Biochem. Soc., Inst. of Rural Science, Penglais, Aberystwyth (Wales), Sept. 13-14, 1962.

Published in Biochem. Jour., v. 85: 12P, Nov. 1962.

Cultures of cambial tissue of Paul's Scarlet Rose grown at room temperature for 14 days in White's medium containing 10% coconut milk and 6 mg/l of 2,4-dichlorophenoxyacetic acid, yielded 200 g l of cells. The cells were extracted with acetone. No chlorophyll was detected in the extracts. After saponification of the extracts, the unsaponifiable matter was 15 mg g dry wt, 1/3 of which was digitonin-precipitable sterols (phytosterols). No ergosterol was found. The hydrocarbon fraction of the sterol-free unsaponifiable matter contained squalene but no colorless C_{40} polyenes. Three xanthophylls were detected; auroxanthin was the main component, 4 ug g dry wt

3163

Washington State U. Dept. of Chemistry, Pullman.

REACTIONS OF NITRYL HALIDES, by H. H. Batey, Jr. Final rept. Nov. 1, 1956-Oct. 31, 1962. Nov. 1, 1962, 4p. (AFOSR-4311) (AF 49(638)36) Unclassified

Research on the reactions of nitryl halides is summarized. Studies undertaken include: (1) the reaction of NO_2Cl with ClF_3; (2) $(NH_4)_2MCl_6$ and $(NO)_2MCl_6$ compounds; (3) exchange reactions using O^{18}; and (4) miscellaneous reactions of NO_2Cl.

3164

Washington State U. [Dept. of Chemistry] Pullman.

THE EFFECT OF STRUCTURAL CHANGES ON THE PYROLYSIS OF ESTERS OF ORGANIC AND INORGANIC ACIDS, by G. G. Smith. Final rept. Jan. 1962. 5p. (AFOSR-2218) (AF 49(638)616) Unclassified

The effect of polar and steric influences on the thermal stability of organic and inorganic esters has been studied. With organic esters, the polar effect on the thermal stability has been studied by determining the reaction rates at several temperatures of over 70 esters. An understanding about the influence of polar groups on reactivity in a solvent free system has been gained. Evidence substantiating the formation of a charged intermediate in ester pyrolysis has been obtained.

3165

Washington State U. Dept. of Chemistry, Pullman.

SUBSTITUENT EFFECTS IN PYROLYSIS. V. A $\rho - \sigma^+$ CORRELATION IN THE PYROLYSIS OF 1-ARYLETHYL ACETATES, by R. Taylor, G. G. Smith, and W. H. Wetzel. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-J280) (AF 49(638)616) AD 415329 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 4817-4824, Dec. 20, 1962.

A kinetic study of the gas-phase thermal decomposition of a number of 1- and 2-arylethyl acetates has been made between 297.8° and 409.2°. Each ester was pyrolyzed at 4 different temperatures and over a temperature range of not less than 50° in a static system at reactant pressures of 6 to 200 mm; the energies and entropies of activation range, respectively, from 41.7 kcal mol and +0.34 to -2.66 e.u. for the 1-arylethyl acetates, and from 44.8 to 45.9 kcal mol and -3.24 to -3.67 e.u. for the 2-arylethyl acetates. A plot of log k_{rel} for the effects of the substituents in the 1-aryl series at 600°K against σ^+-constants (Brown and Okamoto) gives an excellent correlation ($\sigma = -0.66$) thus proving that the elimination of acetic acid proceeds via a mechanism in which some charge separation occurs, as has recently been suggested. The importance of the breaking of the carbon-hydrogen and single carbon-oxygen bonds in the reaction mechanism has been further evaluated. (Contractor's abstract)

3166

[Washington State U. Dept. of Chemistry, Pullman.]

A METHOD FOR ASSESSING ELECTROPHILIC SUBSTITUENT EFFECTS IN THE GAS-PHASE AND THE CORRELATION WITH REACTIVITY IN THE CONDENSED-PHASE, by R. Taylor and G. G. Smith. [1962] [11]p. incl. diagrs. tables, refs. (AFOSR-J913) (AF 49(638)616) Unclassified

Also published in Tetrahedron, v. 19: 937-947, June 1963.

Substituent effects in the gas-phase pyrolysis of 1-arylethyl acetates (a reaction which proceeds via a transition state of carbonium ion character) are compared with those obtained in condensed-phase electrophilic aromatic substitutions and related reactions, and are found to closely parallel them. The p-methyl and p-t-butyl substituents activate in the inductive order, disproving the contention that the Baker-Nathan effect is primarily a function of the resonance requirement of a particular reaction. It is shown that the variable reactivity of the para-position in biphenyl in electrophilic and related reactions is unlikely to be attributable to an energy barrier restricting the attainment of a coplanar form, and that the electrophilic reactivity of the 2-position in fluorene cannot be satisfactorily represented by a single substituent constant. Sigma values in reactions proceeding via electron deficient centers are revealed as being partially dependent upon the extent of solvation though this effect is relatively minor. The pyrolysis reaction promises to be of fundamental value for examining the effects of substituents known to be strongly susceptible to solvent effects in condensed-phase reactions. Steric effects in the reaction are discussed. (Contractor's abstract)

3167

Washington State U. [Dept. of Physics] Pullman.

EFFECTS OF GLASS CONTAMINATION AND ELECTRODE CURVATURE ON ELECTRICAL BREAKDOWN IN VACUUM, by E. E. Donaldson and M. Rabinowitz. [1962] [4]p. incl. illus. diagrs. (AFOSR-J557) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-86 and Atomic Energy Commission) AD 408600 Unclassified

Also published in Jour. Appl. Phys., v. 34: 319-322, Feb. 1963.

It has recently been found that particles of contamination reside on surfaces inside vacuum systems as a result of thermal decomposition of glass. These particles contain at least Na, K, and B as well as traces of Al and Si. They may well have been important in many clean surface experiments. This investigation has shown that these particles have a strong influence in reducing the breakdown voltage in vacuum. Breakdown voltages for Al, Cu, and stainless steel electrodes with radii of curvature of 21.7, 25.4, 50.8, and 101.6 mm were determined under clean and contaminated conditions at 10^{-5} Torr. It was found that under clean conditions the

electrodes of smaller radii of curvature have higher breakdown voltages than the more nearly plane electrodes. (Contractor's abstract)

3168

Washington State U. [Dept. of Physics] Pullman.

CHEMICAL SPUTTERING OF TUNGSTEN AT ELEVATED TEMPERATURES, by H. F. Winters, D. R. Denison and others. [1962] [7]p. incl. illus. diagrs. refs. (AFOSR-J1073) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-86 and Atomic Energy Commission) Unclassified

Also published in Jour. Appl. Phys., v. 34: 1810-1816, June 1963.

Positive ions emitted from heated tungsten filaments operating in various gas environments and in residual gases remaining at 10^{-11} Torr have been investigated. The ions appear both as a continuous current and in the form of ion bursts. The pressure and temperature dependence of the ion current is given; the properties of the bursts are investigated; and a model for the mechanism of burst production is proposed. It is shown that the ion current can be used as a sensitive indicator of surface reactions.

3169

Washington State U. [Dept. of Physics] Pullman.

INVESTIGATION OF POSITIVE-ION EMISSION FROM FILAMENTS (Abstract), by D. R. Denison and H. F. Winters. [1962] [1]p. [AF AFOSR-62-86] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 443, Aug. 27, 1962.

Positive ions emitted from heated tungsten filaments operating in atmospheres of N_2, H_2, O_2, CO, CO_2, and residual gases remaining at 10^{-10} Torr have been investigated. The ions appear both as a continuous ion current and in bursts of 10^3 to 10^7 ions. The pressure and temperature dependence of the ion current is given; the properties of the bursts are investigated; and a model for the mechanism of burst production is proposed.

3170

Washington State U. [Dept. of Psychology] Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF CONTEXTUAL CONSTRAINT, by K. E. Lloyd and W. A. Johnston. [1962] [8]p. incl. tables, refs. (AFOSR-J750) (AF 49(638)805) AD 413636 Unclassified

Also published in Jour. Exper. Psychol., v. 65: 460-467, May 1963.

Contextual constraint has improved recall in the classic memory span task. Here this variable was manipulated in a sequential memory task in which S continually received information, and, at unpredictable moments, was requested to recall some of it. In experiment I, 24 undergraduates continuously stored an average of 3 or 7 items and recalled them 2 at a time. This required many recall points which interrupted the contextual passages. The effect of varying contextual constraint was significant ($p < .01$), but small. In experiment II, interruptions were gradually reduced by requesting more and more items per recall point. Recall improved ($p < .01$) as constraint increased and as interruptions decreased; these variables interacted. Interruptions severely curtailed the benefits of context. (Contractor's abstract)

3171

Washington U. [Dept. of Mathematics] St. Louis, Mo.

IMAGE-SHARING ENDOMORPHISMS AND LINEAR EQUATIONS, by F. Halmo. [1962] [15]p. (AF 49(638)-218 and AF AFOSR-62-413) Unclassified

Published in Topics in Abelian Groups; Proc. of the Symposium, New Mexico State U., University Park (June 4-8, 1962), ed. by J. M. Irwin and E. A. Walker. Scott, Foresman and Co., Chicago [1963] p. 337-347.

This paper deals with systems of linear equations over abelian groups, where the coefficients are endomorphisms. The main result of the paper is the following interesting generalization of Cramer's rule. Let G be a 2-divisible abelian group ($2G = G$) and S a commutative ring of endomorphisms of G. Let (s_{ij}) be an n-by-n matrix of elements of S such that $\det(s_{ij})$ is an automorphism of G. Then the system of n equations in n unknowns $x_1 s_{11} + \ldots + x_n s_{1n} = b_1$ $(i = 1, \ldots, n)$, with $b_i \in G$, has a unique solution in G. (Math. Rev. abstract)

3172

Washington U. [Dept. of Mathematics] St. Louis, Mo.

LAGUERRE TRANSFORMS, by I. I. Hirschman, Jr. [1962] [14]p. (AF 49(638)846) Unclassified

Published in Duke Math. Jour., v. 30: 495-510, Sept. 1963.

Let L_n be the n^{th} Laguerre polynomial. Consideration is given to the transformation of sequences defined by $F(n) = \sum_{m=0}^{\infty} G(n, m)\, f(m)$, where the "kernel" $G(n, m)$ has the form $G(n, m) = \int_0^{\infty} (E(x))^{-1} L_n(x) L_m(x) e^{-x} dx$, where E(x) is a member of a special class of positive functions previously studied. Exploiting the recursion formula for the polynomials L_n, an inversion formula for the transformation $f \to F$, which is analogous to the Post-Widder inversion formula for the Laplace transform, is constructed. Necessary and sufficient conditions that F(n) have the form $\sum_{m=0}^{\infty} G(n, m)\, f(m)$ with $f(m) \geq 0$ are also established. (Math. Rev. abstract)

3173

Washington U. [Dept. of Physics] St. Louis, Mo.

SPIN-SPIN INTERACTION IN DIMERS OF FREE RADICALS, by N. Hirota and S. I. Weissman. [1962] [2]p. incl. diagr. (AFOSR-2568) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)464, National Science Foundation, Office of Naval Research, and Petroleum Research Fund) AD 295296 Unclassified

Also published in Molec. Phys., v. 5: 537-538, Sept. 1962.

Variations of the optical absorption spectra of certain ketyls with concentration suggest an equilibrium between monomeric and dimeric forms of similar electronic structure. Electron spin resonance spectroscopy confirms the existence of species containing 2 unpaired electrons. The phenomenon has been observed in several substances but in this note only the behavior of the alkali metal ketyls of fluorenone is described.

3174

Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRON TRANSFER BETWEEN TRIS-p-NITROPHENYLMETHYL RADICAL AND TRIS-p-NITROPHENYLMETHIDE ION STUDIED BY ELECTRON SPIN RESONANCE TECHNIQUES, by M. T. Jones and S. I. Weissman. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-2575) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)464] and Office of Naval Research) AD 295929 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 4269-4274, Nov. 1962.

The rate constants and the activation energies for the electron transfer between tris-p-nitrophenylmethyl radical and tris-p-nitrophenylmethide ion for all combinations of the sodium or potassium salts in 1, 2-dimethoxyethane, tetrahydrofuran, pyridine, and acetonitrile have been measured by electron spin resonance (esr) methods. The rates lie in the range 10^7 to 10^9 liter mol^{-1} sec^{-1}. The activation energies lie in the range 0.3 to 2.3 kcal mol^{-1}. The analysis of the rate constants and the activation energies is straightforward except for the case of the sodium tris-p-nitrophenylmethide in THF, where the dependence of rate on total methide concentration is not linear. In a particular solvent, the sodium salt yields a slower rate than the potassium salt except in acetonitrile. (Contractor's abstract)

3175

Washington U. [Dept. of Physics] St. Louis, Mo.

SPIN DISTRIBUTION IN KETYL RADICALS, by N. Hirota. [1962] [2]p. incl. diagr. (AFOSR-2579) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)464], National Science Foundation, Office of Naval Research, and Petroleum Research Fund) AD 295927; AD 294405 Unclassified

Also published in Jour. Chem. Phys., v. 37: 1884-1885, Oct. 1962.

Various types of benzophenone ketyls were prepared by the reaction with alkali, alkaline earth, and rare-earth metals and their esr spectra were studied. In the aliphatic ether solvents, DME, THF, and Me-THF, it was found that the monomer ketyl radicals are ion paired and that the spectra show lines due to splittings by protons and metal; whereas, only the dissociated ketyl-free ion was found in liquid ammonia. The alkali metal splitting changes with temperature and is qualitatively similar to the sodium splitting of the sodium naphtnalenide ion pair. (Contractor's abstract)

3176

Washington U. Dept. of Physics, St. Louis, Mo.

[PARAMAGNETIC RESONANCE OF FREE RADICALS], by R. E. Norberg. Final rept. Sept. 30, 1962 [8]p. incl. refs. (AFOSR-4045) (AF 49(638)464) AD 290686 Unclassified

Research undertaken on the study of paramagnetic resonance of free radicals is summarized under the following subject headings: (1) spin distributions, (2) rates and mechanisms, (3) clusters of free radicals, (4) electron and nuclear double resonance (Endor) studies, and (5) multiple-frequency resonance. A bibliography of work published under this contract is included.

3177

Washington U. Dept. of Physics, St. Louis, Mo.

THE APPLICATION OF MAGNETIC RESONANCE TO SOLID STATE PHYSICS, by R. E. Norberg and J. J. Townsend. Final rept. June 16, 1962 [7]p. incl. diagr. (Technical rept. no. 2) (AFOSR-3029) (AF 49(638)808) AD 282396 Unclassified

This report describes the results of a 2-yr research program. The work proposed envisaged several rather novel experiments and a considerable part of the effort has gone into the development of the necessary techniques and instrumentation. The work has followed 3 distinct lines, which have been carried to varying degress of development: (1) nuclear magnetic resonance in spinning solids; (2) nuclear magnetic resonance in metals; and (3) transient Overhauser effect in metals.

3178

Washington U. Dept. of Physics, St. Louis, Mo.

INVESTIGATION ON THE PRIMARY COSMIC RADIATION, by M. W. Friedlander. Final status rept. no. 2, June 16, 1961-June 15, 1962, 3p. (AFOSR-4299) (AF 49(638)833) AD 293911 Unclassified

Experimental procedures used to investigate fragmentation parameters for heavy nuclei in air, the flux of heavy primaries, geomagnetic effects on cosmic

radiation, and the energy spectrum of alpha particles are briefly described.

3179

Washington U. Dept. of Physics, St. Louis, Mo.

THE STATISTICAL THEORY OF CONDENSATION, by C.-T. Chen-Tsai. Apr. 1962, 46p. incl. diagrs. refs. (Technical rept. no. 3) (AFOSR-2662) (AF 49(638)834) AD 278248 Unclassified

The statistical theory of the condensation of water is treated. Efforts are made to clarify the significant role the interaction potential between particles plays on the condensation phenomenon, and to attain plausibility in mathematical arguments. In Chapter II, Mayer's theory of imperfect gases is recapitulated, and some reasonable assumptions on the pressure vs specific volume curves in the region of validity of the theory are made. In Chapter III, general properties of the pressure vs specific volume curves are discussed. By using the grand canonical ensemble method the characteristic phenomenon of condensation is mathematically derived in Chapter IV. Chapter V presents an exact mathematical treatment of the Einstein condensation to illustrate the proper limiting process of the series expressions for thermodynamic functions for infinite systems.

3180

Washington U. Dept. of Physics, St. Louis, Mo.

[RESEARCH IN THEORETICAL PHYSICS], by E. Feenberg. Final status rept. no. 2, June 16, 1961-June 15, 1962, 4p. (AFOSR-3874) (AF 49(638)834) Unclassified

This report is divided into 3 sections under which the progress of work on theoretical studies is briefly outlined. The 3 divisions are entitled: (1) work completed and ready for publication, (2) work in progress, and (3) generation of distribution functions by function integration.

3181

Washington U. [Dept. of Physics] St. Louis, Mo.

ENERGY SPECTRUM OF ELEMENTARY EXCITATIONS IN HELIUM II, by H. W. Jackson and E. Feenberg. [1962] [8]p. incl. diagrs. table, refs. [Technical rept. no. 2] (AFOSR-4414) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)834 and National Science Foundation) AD 295850 Unclassified

Also published in Rev. Modern Phys., v. 34: 686-693, Oct. 1962.

A recalculation of the spectrum is made using the second-order Brillouin-Wigner energy formula, and the results are compared with those of earlier calculations and experimental data. The calculations are made using, firstly, the Kirkwood superposition approximation for the 3-particle distribution function p (1, 2, 3) and, secondly using a new approximation called the "convolution approximation". A criterion is given for the accuracy of the use of any approximation for p (1, 2, 3), and this is applied to both approximations used. A discussion of the stability of these elementary excitations is given.

3182

Washington U. [Dept. of Physics] St. Louis, Mo.

THEORY OF THE FERMION LIQUID, by F. Y. Wu and E. Feenberg. [1962] [13]p. incl. diagr. table refs. (AFOSR-348) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)834] and National Science Foundation) AD 400189 Unclassified

Also published in Phys. Rev., v. 128: 943-955, Oct. 15, 1962.

The ground-state wave function generated by a system of interacting bosons is used as the correlation factor in a trial function describing the interacting fermion system. Expectation values are computed by the technique of the generalized normalization integral. The resulting cluster integrals are evaluated by introducing simple approximate forms for the n-particle distribution functions defined by the boson wave function. To illustrate the method, it is applied to establish a connection between known results for fermion and boson forms of a hard-sphere system at low density. As a second illustration experimental information on liquid He^4 is used to work out properties of a hypothetical fermion-type system of mass 4. Results are given for the energy, effective mass, and magnetic behavior. The application to He^3 waits on the evaluation of the radial distribution function and liquid structure factor for the corresponding artifical boson system of mass 3. (Contractor's abstract)

3183

Washington U. [Dept. of Physics] St. Louis, Mo.

POLARIZATION OF PROTONS IN $Be^9(d, p)Be^{10}$, by R. G. Allas, R. W. Bercaw, and F. E. Shull. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-2346) (AF 49(638)-843) Unclassified

Also published in Phys. Rev., v. 127: 1252-1257, Aug. 15, 1962.

The polarization of protons from the $Be^9(d, p)Be^{10}$ reaction has been measured at an incident deuteron energy of 10 mev. The measurement has been carried from 13° (lab) to 90° (lab). The polarization is positive at forward angles but changes sign at about 70° (lab). Elastic scattering of protons from helium and carbon was used as the analyzing reaction. The axis of quantization is taken as $n = k_d \times k_p$. (Contractor's abstract)

3184

[Washington U. Dept. of Physics, St. Louis, Mo.]

EXPERIMENTAL STUDIES IN NUCLEAR PHYSICS, by F. B. Shull. Final status rept. no. 2, June 15, 1961-June 21, 1962 [28]p. incl. diagrs. refs. (AFOSR-3280) (AF 49(638)843) Unclassified

Research conducted under this contract is enumerated and described in some detail. The major categories of study are: 1) polarization of nucleons from deuteron stripping reactions, (2) angular variation of (d, α) cross sections, (3) the KL_I transitions in high Z elements, (4) Mössbauer effect in Sn-119, and (5) β-decay of Cl^{40}. Publications resulting from these studies are listed.

3185

Washington U. [Dept. of Physics] St. Louis, Mo.

ANGULAR DISTRIBUTIONS OF α PARTICLES FROM F^{19}(d, α)O^{17} (Abstract), by J. M. Fowler, J. B. Reynolds and others. [1962] [1]p. [AF 49(638)843] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 287-288, Apr. 23, 1962.

The angular distributions of α particles produced in the bombardment of thin (1/8-mil Teflon) F^{19} targets with 10-mev deuterons have been measured at 7½° intervals from 7½° to 142½° (and occasionally greater) laboratory angles. α particles leaving O^{17} in its ground- and first-excited states were detected with solid-state detectors. Absolute, as well as relative, cross sections were measured. All 4 angular distributions exhibit the oscillations characteristic of direct reactions. The ground-state angular distribution rises sharply in the forward direction and peaks at approximately 12° cm with 3 smaller peaks at greater angles. The first-excited state (0.871 mev) angular-distribution peaks at 23° cm shows 2 smaller peaks and rises to a peak at 155° cm as pronounced as the forward one. The second-excited-state (3.058 mev) angular distribution has a prominent forward peak at 20° cm, smaller peaks at intermediate angles, and is rising again at 147° cm. The third-excited state (3.846 mev) angular distribution is similar. Attempts to fit these data with various direct reaction theories are discussed

3186

Washington U. [Dept. of Physics] St. Louis, Mo.

DIFFERENTIAL CROSS SECTIONS OF THE Be^9(d, α)Li^7 AND Al^{27}(d, α)Mg^{25} REACTIONS (Abstract). by J. J. Wesolowski, J. M. Fowler and others. [1962] [1]p. [AF 49(638)843] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 269, Apr. 23, 1962.

The reactions Be^9(d, α)Li^7 and Al^{27}(d, α)Mg^{25} have been investigated at the cyclotron with 10-mev deuterons. The differential cross sections between laboratory angles 7½° to 165° were measured for the ground-state and first excited-state α particles from the beryllium and for the ground-state and several excited-state α's from the aluminum reaction. Absolute differential cross sections were measured for both reactions. The α particles were detected with solid-state counters. A thin aluminum foil (approximately 0.18 mg/cm²) was used in the aluminum reaction, and a self-supporting evaporated film of beryllium was used in the beryllium reaction. The angular distribution for the ground-state α's from Al^{27}(d, α)Mg^{25} shows, in addition to a forward peak, a weak maximum in the backward direction. The backward peaking of the α's from Be^9(d, α)Li^7 is particularly pronounced both for the ground state and first-excited state.

3187

Washington U. [Dept. of Physics] St. Louis, Mo.

DIFFERENTIAL CROSS SECTIONS OF THE N^{14}(d, α)C^{12}, P^{31}(d, α)Si^{29}, AND V^{51}(d, α)Ti^{49} (Abstract), by R. J. Wilson, J. M. Fowler and others. [1962] [1]p. [AF 49-(638)843] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 286, Apr. 23, 1962.

The angular distribution of the α particles from the reactions N^{14}(d, α)C^{12}, P^{31}(d, α)Si^{29}, and V^{51}(d, α)Ti^{49} were obtained at a deuteron energy of 10 mev using solid-state detectors. Very thin N^{14} targets were prepared by evaporating Melamine ($N_6H_6C_3$) in vacuum onto a thin film (10 μg/cm² or less) of polyvinyl chloride acetate. Thin P^{31} targets were prepared by placing water slurries of very fine mesh, amorphous red phosphorous onto ¼-mil films of Mylar and allowing the water to evaporate. The V^{51} targets were prepared by evaporating vanadium onto extremely thin carbon films. Angular distributions were also obtained for α particles leaving C^{12} in the first-excited state (4.43 mev) and Si^{29} in the first-excited state (1.28 mev). The absolute cross sections for all 3 reactions were measured.

3188

Washington U. [Dept. of Physics] St. Louis, Mo.

PROTON POLARIZATION IN B^{10}(d, p)B^{11} AND Si^{28}(d, p)Si^{29} WITH 10-MEV DEUTERONS (Abstract), by R. W. Bercaw and F. B. Shull. [1962] [1]p. [AF 49(638)843] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 269, Apr. 23, 1962.

The polarization of the reactions P(θ) was studied using $C^{12}(p,p)C^{12}$ at 50° (laboratory) as an analyzer. The right-left asymmetry of the carbon-scattered protons were measured by 2-counter telescopes. For the boron ground-state reaction, P is positive (Basel convention) up to 100° where it changes sign; its maximum value is +0.23 ± 0.06 at 37.5°. Agreement is good with data at 8.9 and 7.8 mev, but differs in sign at 11.4 mev. Reactions to the 2.14-mev and to the unresolved 4.46- and 5.03-mev excited states of B^{11} were studied over narrower ranges of angle; for the former, P was found negative near 60°, consistent with the assumption that spin-flip occurs; for the latter, P was positive throughout the stripping peak, indicating neutron capture with $j = \ell + \frac{1}{2}$. For the silicon ground-state reaction, where $\ell = 0$, P was found to be nonzero in the measured range (7° to 80°); it is roughly similar to data at 15 mev.

3189

Washington U. Dept. of Physics, St. Louis, Mo.

EFFECTS OF ION ASSOCIATION ON RATES OF OXIDATION-REDUCTION TRANSFER REACTIONS IN THE NAPTHALENE-NAPTHALENIDE SYSTEMS, by P. J. Zandstra and S. I. Weissman. [1962] [3]p. incl. diagrs. table. (AFOSR-J145) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-365, National Science Foundation, Office of Naval Research, and Petroleum Research Fund)
AD 296214 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 4408-4410, Dec. 5, 1962.

The rates of the rapid reactions: (1) $C_{10}H_8^- + C_{10}H_8 = C_{10}H_8 + C_{10}H_8^-$; (2) $C_{10}H_8^-Na^+ + C_{10}H_8 = C_{10}H_8 + Na^+C_{10}H_8^-$ have been measured in tetrahydrofuran, tetrahydropyran and 2-methyltetrahydrofuran. The processes follow a second order kinetic law. The rates and their variation with temperature depend on solvent. Reaction rate of (1) is generally more rapid than (2), but in tetrahydrofuran the rate of (2) increases with decreasing temperature below 300°K and is greater than the rate of (1) below 280°K. (Contractor's abstract)

3190

Washington U. Dept. of Physics, St. Louis, Mo.

PROTON MAGNETIC RESONANCE STUDIES IN SODIUM-AMMONIA SOLUTIONS, by T. R. Hughes, Jr. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-J341) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-365, Alfred P. Sloan Foundation, National Institutes of Health, and Office of Naval Research) AD 408060 Unclassified

Also published in Jour. Chem. Phys., v. 38: 202-209, Jan. 1, 1963.

High-resolution techniques have been applied to the measurements of the proton magnetic resonance shifts in sodium-ammonia solutions. Concentrations ranging from $R = 1.6 \times 10^{-4}$ to 1.7×10^{-1} were studied, and the temperature was varied from below -70° to above +25°C. The miscibility gap was noted in the relatively concentrated solutions. In dilute solutions, a triplet, arising from the spin-spin interaction of the nitrogen nucleus on the proton nuclei within an ammonia molecule, was sometimes observed. In order to interpret the data taken on samples having a mol rate $R \leq 1.15 \times 10^{-2}$, a modified form of the Knight shift expression applicable to this system is derived:

$$\left(\frac{\Delta H}{H_0}\right)_I = -\frac{8\pi}{3L_0} D(I) \chi_{e,\ theo},$$

where $\chi_{e,\ theo} = L_0 \mu_e^2/kT$. Using this relation, the data taken at -33.2°C are found to offer strong support for the existence of some kind of monomers down to $R \leq 3.41 \times 10^{-4}$. The value deduced for the total negative spin density of the electron on the monomer protons is -8.1×10^{23} cm^{-3} using the equilibrium constants of Becker, Lindquist, and Alder. Application of this same formalism to published Knight shift data yields corresponding values for the total electron density associated with the monomer of 9.0×10^{24} cm^{-3} on the nitrogen nuclei and of approximately 3.3×10^{22} cm^{-3} on the sodium-ion core. The possibility that the electron relaxation occurs on the monomer rather than on the ammonia molecules bordering a singly occupied cavity is also discussed.

3191

Washington U. [Dept. of Physics] St. Louis, Mo.

THE CLEAVAGE OF ARYL ETHERS BY ALKALI METALS IN ALIPHATIC ETHER SOLVENTS. DETECTION BY ELECTRON SPIN RESONANCE, by D. H. Eargle, Jr. [1962] [3]p. incl. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-365] and Office of Naval Research)
Unclassified

Presented at 141st National meeting of the Amer. Chem. Soc., Washington, D. C., Mar. 1962.

Published in Jour. Org. Chem., v. 28: 1703-1705, June 1963.

The cleavage of several types of aromatic ethers was investigated in a variety of inert aliphatic ether solvents by using the alkali metals Li, Na, K, Rb, and Cs. The reaction was first detected in a study of spin exchange in the singly and doubly charged anions of biphenylyl ether. As a typical example, the cleavage by Na and subsequent work-up of 9-naphthyl ether (I) was described. I (1 g) was placed in an outgassed tube which was then mirrored with 0.2 g Na (by distillation 3 times through constrictions in a side tube), 4 cc dimethoxyethane distilled into the tube, the whole degassed, the tube sealed, the mixture shaken 2 or 3 times to contact the

metal mirror, then shaken 1 hr longer. The contents were neutralized with dilute H_2SO_4, 20 ml Et_2O added, and the whole extracted with $NaHCO_3$, then with NaOH. The acidified $NaHCO_3$ extract yielded only a thin film having the odor of aliphatic acids. The acidified NaOH extract yielded 0.30 g β-naphthol, mp 122°. The neutral fraction was fractionally sublimed to give 0.20 g naphthalene and 0.13 g β-dinaphthyl, mp 181-183.5°, and a small amount of a high melting material not identified. Product yields and reactivity were greatest with the larger aryl groups: 60% p-phenylphenol from biphenylyl ether to about 8% PhOH from Ph_2O. The alkali metals were reactive in the order expected: Li < Na < K < Rb < Cs. Product analysis and the electron spin resonance indicated that the reaction proceeded through a heterolytic cleavage of the aryl C-O bond of the dinegative ion.

3192

Washington U. Dept. of Physics, St. Louis, Mo.

PRIMARY COSMIC-RAY ALPHA PARTICLES - III, by M. W. Friedlander and C. T. Spring. [1962] [9]p. incl. diagr. table, refs. (AFOSR-J382) (AF AFOSR-62-404) AD 406451 Unclassified

Also published in Nuovo Cimento, Series X, v. 26: 1292-1300, Dec. 16, 1962.

Nuclear photographic emulsions were exposed to the cosmic radiation on a high altitude balloon flight at 49° N geomagnetic latitude on Aug. 3, 1958. The total flux of primary α-particles, having kinetic energies greater than 400 mev/nucleon, was found to be (87 ± 8) particles/m^2 ster s. Simultaneously, another set of emulsions was exposed at 61° N geomagnetic latitude. A comparison of the data obtained from the 2 flights leads to an estimate of the geomagnetic cut-off for 49° N as (500 ± 50) mev/nucleon kinetic energy. (Contractor's abstract)

3193

Washington U. Dept. of Physics, St. Louis, Mo.

COULOMB ENERGY OF He^3 AND CHARGE DISTRIBUTION OF NUCLEON, by H. Ohmura and T. Ohmura. [1962] [5]p. incl. tables. (Technical rept. no. 1) (AFOSR-J37) [AF AFOSR-62-412] AD 297042 Unclassified

Also published in Phys. Rev., v. 128: 729-733, Oct. 15, 1962.

The effect of finite nucleon size on the Coulomb energy of He^3 has been investigated. The experimental value of the difference between the binding energies of H^3 and He^3 is 0.764 mev, while the calculated Coulomb energy is approx equal to or greater than 1.0 mev if the nuclear force has no repulsive core. If the finite size of nucleon is taken into consideration, the Coulomb energy of H^3 is reduced by about 15-20%. The effect of finite charge distribution is determined mainly by the mean square radius. If there is a hard core (with radius D), the calculated Coulomb energy (assuming point nucleons) is already smaller, with the values 0.8—0.9 mev for D = 0.2×10^{13} cm, ~0.7 mev for D = 0.6×10^{13} cm. The reduction of Coulomb energy due to the finite size is about 8% and 3%, respectively, for 2 different models. The Coulomb potential between extended unpolarized nucleons is given in closed form for exponential and Yukawa charge distributions. (Contractor's abstract)

3194

Washington U. Dept. of Chemistry, Seattle.

ELECTRONIC SPECTRUM OF 4,4'-bis DIMETHYLAMINO FUCHSONE AND RELATED TRIPHENYLMETHANE DYES, by F. C. Adam and W. T. Simpson. Sept. 2, 1958 [18]p. incl. diagrs. tables. (AFOSR-4912) (AF 18(600)375) AD 259223; AD 414930 Unclassified

Also published in Jour. Molec. Spectros., v. 3: 363-380, Aug. 1959.

For abstract see item no. WAU.01:024, Vol. II.

3195

Washington U. Dept. of Chemistry, Seattle.

ANOMALOUS SHAPES OF HYBRID ORBITALS, by W. T. Simpson. [1962] [2]p. incl. diagr. (AFOSR-2195) (AF 49(638)677) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 2853-2854, Aug. 5, 1962.

In the framework of the ligand field theory, it is shown that hybridization diminishes a higher p orbital in the direction of a ligand while augmenting a lower s orbital in this same direction. (Contractor's abstract)

3196

Washington U. Dept. of Chemistry, Seattle.

VALENCE-BOND STRUCTURES AND MATRIX ELEMENTS FOR ANY MULTIPLICITY, by R. E. Kellogg. [1962] [2]p. incl. diagr. (AFOSR-2481) (AF 49(638)-677) AD 412623 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2950-2951, Dec. 15, 1962.

A simple method of obtaining an independent set of valence-bond wavefunctions of any multiplicity and of evaluating the matrix elements is given. (Contractor's abstract)

3197

Washington U. Dept. of Chemistry, Seattle.

THEORY OF THE INTERACTION OF LOCALIZED ELECTRONIC EXCITATIONS, by W. T. Simpson. [1962] [14]p. (AF 49(638)677) Unclassified

Presented at Tenth annual meeting of the Radiation Research Soc., Colorado Springs, Colo., May 20-23, 1962.

Also published in Radiation Research, v. 20: 87-100, Sept. 1963.

The matrix element connecting electronic excitation on a molecule at r in interaction with electronic excitation on a molecule at the origin is calculated by using quantum electrodynamics and perturbation theory to the first nonvanishing order. For transition moments, m_z, parallel to the z-axis, the matrix element is found to be

$$m_z^2 \left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right) \frac{e^{-ik_0 r}}{r}$$

This result agrees with one found previously by using a semiclassical argument; also, the result goes over into the well-known coulombic interaction matrix element (dipole approximation) when $k_0 \rightarrow 0$.

3198

Washington U. Dept. of Chemistry, Seattle.

VAPOR PRESSURE STUDIES OF SULFUR TRIOXIDE AND THE WATER-SULFUR TRIOXIDE SYSTEM, by J. H. Colwell and G. D. Halsey, Jr. [1962] [4]p. incl. illus. diagr. table, refs. (AFOSR-2599) [AF 49(638)-723] Unclassified

Also published in Jour. Phys. Chem., v. 66: 2179-2182, Nov. 1962.

The vapor pressures of liquid and γ-SO_3 (trimeric form, mp 16.86°) have been determined in an all-glass apparatus. The vapor pressure of the so-called β-SO_3, which is only formed in the presence of $> 10^{-5}$ mol fraction of water, also is reported. Vapor pressure and melting point studies of the H_2O—SO_3 system are reported in the range of 0.8 mol fraction SO_3 upward. The solutions so formed solidify at constant temperature to form a solid solution of the same composition as the melt. A syneresis upon standing for several weeks was observed in the 0.999 mol fraction SO_3 sample.

3199

Washington U. Dept. of Chemistry, Seattle.

QUANTUM TREATMENT OF THE PHYSICAL ADSORPTION OF ISOTOPIC SPECIES, by R. Yaris and J. R. Sams, Jr. [1962] [6]p. incl. tables, refs. (AFOSR-2600) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)723] and American Petroleum Institute) Unclassified

Also published in Jour. Chem. Phys., v. 37: 571-576, Aug 1, 1962.

The results of isotopic substitution in the adsorption of H_2, D_2, CH_4, and CD_4 on a graphitized carbon black observed by Constabaris, Sams, and Halsey are explained in terms of 2 competing effects; the quantum statistical mass effect on the vibrational energy levels normal to the surface and the quantum mechanical effect of isotopic substitution on the dispersion energy. (Contractor's abstract)

3200

Washington U. [Dept. of Chemistry] Seattle.

POLARIZABILITY CHANGE IN LIQUIDS DUE TO MANY-BODY INTERACTIONS, by R. Yaris and B. Kirtman. [1962] [5]p. incl. table, refs. (AFOSR-2602) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)723 and Office of Naval Research) Unclassified

Also published in Jour Chem. Phys., v. 37: 1775-1779, Oct. 15, 1962.

Approximate quantum-mechanical expressions for the change in polarizability due to many-body interactio... in spherically symmetric liquids, or dense gases, are derived by a variational form of perturbation theory. These expressions are evaluated using Linder's continuum model for the liquid and Slater-type wavefunctions. It is shown that the change in polarizability is approximately $[3g\alpha^2/8(ea_0)^2]$, where α is the unperturbed polarizability and g is a parameter which depends on the dielectric constant and molar volume of the liquid. The predicted increase in polarizability varies from 0.042% for He to 3.54% for Xe. (Contractor's abstract)

3201

Washington U. Dept. of Chemistry, Seattle.

ADSORPTION ISOTHERMS OF NEON, ARGON, KRYPTON, XENON, HYDROGEN, DEUTERIUM, METHANE, AND TETRADEUTEROMETHANE ON THE HIGHLY GRAPHITIZED CARBON BLACK P33 (2700°), by G. Constabaris, J. R. Sams, Jr., and G. D. Halsey, Jr. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-723] and American Petroleum Institute) Unclassified

Published in Jour. Chem. Phys., v. 37: 915, Aug. 15, 1962.

The availability of several adsorption isotherms in temperature ranges up to 300°K is announced and instructions for ordering are given.

3202

Washington U. Dept. of Chemistry, Seattle.

ADSORPTION OF ARGON ON GRAPHITIZED CARBON BLACK. SURFACE AREA AND HEATS AND ENTROPIES OF ADSORPTION, by J. R. Sams, Jr., G. Constabaris, and G. D. Halsey, Jr. [1962] [5]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)723] and American Petroleum Institute) Unclassified

Published in Jour. Phys. Chem., v. 66: 2154-2158, Nov. 1962.

Adsorption isotherms of argon on the highly graphitized carbon black P33 (2700°) between 90 and 137°K are presented. Estimates of the surface of the adsorbent and heats and entropies of adsorption computed from the data are discussed. The present results are compared with quantities obtained through the virial coefficient treatment of physical adsorption. (Contractor's abstract)

3203

Washington U. Dept. of Chemistry, Seattle.

THE PROPERTIES OF α-SULFUR TRIOXIDE, by J. H. Colwell and G. D. Halsey, Jr. [1962] [3]p. incl. diagrs. tables, refs. [AF 49(638)723] Unclassified

Published in Jour. Phys. Chem., v. 66: 2182-2184, Nov. 1962.

Numerous attempts were made to produce stable samples of α-SO_3, but all samples spontaneously decomposed to liquid SO_3. An irreversible transition was found to occur at -65° upon warming samples formed by depositing SO_3 vapor on cooled surfaces. The heat of transition, ΔH = -2500 cal was measured using a specially designed ice calorimeter. A mechanism for the formation of α-SO_3 is proposed. (Contractor's abstract)

3204

Washington U. Dept. of Chemistry, Seattle.

EFFECT OF CENTRIFUGAL DISTORTION ON THE SHAPE OF THE HYDROGEN SULFIDE FUNDAMENTAL INFRARED BANDS, by M. T. Emerson and D. F. Eggers, Jr. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-2158) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)797 and National Science Foundation) AD 446158 Unclassified

Also published in Jour. Chem. Phys , v. 37: 251-259, July 15, 1962.

The fundamental infrared vibration bands of hydrogen sulfide exhibit an interesting intensity anomaly characterized by P branches which are much weaker than the corresponding R branches. This work shows that this anomaly is caused by centrifugal distortion of the nonrigid molecule. A formalism based on a semi-classical approach is used to calculate the vibration—rotational line positions and their intensities. The computed theoretical spectra are in good agreement with the experimental spectra. This formalism also gives a method of determining the relative sign of $(\partial\mu/\partial Q)$ with respect to μ_0. The values of $(\partial\mu/\partial Q)$ needed in the calculations were obtained from the experimental integrated band intensities and were found to be $(\partial\mu/\partial Q_1) = -4.4$ esu $g^{-\frac{1}{2}}$ and $(\partial\mu/\partial Q_2) = +8.7$ esu $g^{-\frac{1}{2}}$. (Contractor's abstract)

3205

Washington U. Dept. of Chemistry, Seattle.

EQUILIBRIA AND PREPARATIVE METHODS FOR BORON AND SILICON COMPOUNDS, by D. M. Ritter. Final rept. Nov. 1, 1962, 3p. (AFOSR-4371) (AF 49-(638)937) Unclassified

Work has been carried out on vinylboranes, alkylated diboranes, alkylated higher boranes, and boron silicon bonded compounds. Results of this work are listed and include 6 papers which have been published and 2 in advanced stages of preparation. A summary is given of current work being continued on: (1) the reactions of the vinylboranes, (2) synthesis of compounds containing boron-silicon bonds, (3) boron anions, and (4) kinetics and equilibria in the alkylation of boron hydrides.

3206

Washington U. Dept. of Chemistry, Seattle.

THE RELATION BETWEEN CONFORMATION AND LIGHT ABSORPTION IN POLYPEPTIDES AND PROTEINS, by I. Tinoco, Jr., A. Halpern, and W. T. Simpson. [1362] [11]p. incl. diagrs. tables, refs. (AFOSR-J655) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-63-64, Public Health Serivce, and Research Corporation) AD 415108 Unclassified

Also published in Polyamino Acids, Polypeptides, and Proteins; Proc. of Internat'l. Symposium, Wisconsin U., Madison (June 19-24, 1961), ed. by M. A. Stahmann. Madison, Wisconsin U. Press, 1962, p. 147-157.

Good agreement between theory and experiment is found for the α-helix absorption. Both the helix intensity and the helix band splitting can be interpreted quantitatively in terms of interactions among the amide and side-chain transition dipoles and polarizabilities. Predictions about the polarization of the absorption intensity have been made. (Contractor's abstract)

3207

Washington U. Dept. of Electrical Engineering, Seattle.

MAN-COMPUTER INTERFACE STUDY, by D. L. Johnson and A. L. Kobler. June 1962, 41p. incl. refs. (AFOSR-3865) (AF 49(638)1070) AD 287791; AD 291144 Unclassified

A study and analysis are presented of the existence and placement of the human-computer interface in digital computer solutions of mixed system problems. Three major areas are being dealt with specifically and will be continued during the next research period: (1) attitudes toward computers, (2) machine learning techniques, and (3) memory and meaning operation and organization for association and retrieval. These 3 areas are being examined in respect to their potential in moving or fixing the man-machine interface in various types of problems. An effort is being carried out to develop specific information leading to a better understanding of computer

learning techniques and meaning processes in respect to their effect upon interface placement. (Contractor's abstract)

3208

Washington U. Dept. of Electrical Engineering, Seattle.

THE MAN-COMPUTER RELATIONSHIP, by D. L. Johnson and A. L. Kobler. [1962] [22]p. (Bound with its AFOSR-3865; AD 287791; AD 291144) (AF 49(638)-1070) Unclassified

Published in Science, v. 138: 873-879, Nov. 23, 1962.

The levels of human knowledge of the environment and the universe are increasing, and it is obviously necessary that man's ability to cope with this knowledge should increase for his very survival. The processes of automation have provided a functional agent for this purpose. Successful mechanized solution of routine problems has directed attention toward the capacity of the computer to arrive at apparent or real solutions of routine-learning and special problems. The computer is being called on to act for man in areas where man cannot define his own ability to perform and where he feels uneasy about his own ability to perform and where he would like a neat, well-structured solution and feels that in adopting the machine's partial solution he is closer to the "right" than is in using his own. An aura of respectability surrounds a computer output, and this, together with the time-balance factor, makes unqualified acceptance tempting. The need for caution, then, already exists and will be much greater in the future. It has little to do with the limited ability of the computer per se, much to do with the ability of man to realistically determine when and how he must use the tremendous ability which he has developed in automation.

3209

Washington U. Dept. of Physics, Seattle.

ABSENCE OF A LINEWIDTH TRANSITION FOR THE PROTONS IN KH_2PO_4-TYPE CRYSTALS, by J. L. Bjorkstam, E. D. Jones and others. [1962] [2]p. incl. diagrs. table, refs. (AFOSR-4436) (AF 49(638)92) AD 295931 Unclassified

Also published in Jour. Chem. Phys., v. 37: 469-470, Aug. 1, 1962.

The linewidth and shape of the proton resonance in KH_2PO_4 is described, and the nonexistence of a linewidth transition in the range of 77° to 300°K is discussed. The calculated and experimental values of the second moment are about 1.5 G^2. (Contractor's abstract)

3210

Washington U. [Dept. of Physics] Seattle.

ACOUSTIC EXCITATION OF NUCLEAR SPIN TRANSITIONS IN NaCl (Abstract), by H. P. Mahon, Jr. and E. A. Uehling. [1962] [1]p. [AF 49(638)92] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 38, Jan. 24, 1962.

The probability of nuclear spin transitions in NaCl induced in single phonon interactions of the spin and lattice vibrations is studied by a method which differs considerably from 2 others reported previously. Measurements of spatial distribution of acoustic excitation energy and total rate of decay of this energy are made. Losses due to mode conversion, poor geometry, and transmission across boundaries are negligible under conditions of the experiment. The remaining loss due to intrinsic attenuation is measured. A new method is given for measuring energy distribution at the surface which shows that a single fundamental vibrational mode is excited. Results include sound attenuation measurements at 15 mc/sec in NaCl and the nuclear spin transition probability. An unexplained variation in attenuation (0.15 to 0.003 cm^{-1}) is measured among samples of equally good optical quality. The spin transition probability is given in terms of an enhancement factor γ_1. $\gamma_1 = 17$ is obtained for Na in NaCl. This is considerably larger than $\gamma_1 = 4$ reported previously using another method. Other comparisons that may be made are with a static $\gamma_0 = 10$ found in molecular beam measurements and a second order process enhancement $\gamma_2 = 60$ obtained from relaxation measurements.

3211

Washington U. [Dept. of Physics] Seattle.

CHANGE OF THE VELOCITY OF SOUND IN METALS IN A MAGNETIC FIELD (Abstract), by A. G. Beattie, H. B. Silsbee, and E. A. Uehling. [1962] [1]p. [AF 49(638)92] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-25 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 478-479, Aug. 27, 1962.

Recent measurements in this laboratory confirm a result reported previously, that, in a metal at room temperature, the velocity of a longitudinal sound wave propagated in a direction perpendicular to an applied magnetic field may increase by as much as 1 part in 10^5 in fields of the order of 10 kG. The previous measurements were on Sn and Al, while the present measurements are on Al and Mg. However, the methods of measurement are quite different. The first depends upon

the measurement of a phase difference, while the second uses the change in the mechanical reactance of a rod in which a standing-wave pattern is established. All 4 results are in fairly good agreement with a previously derived phenomenological theory which states that the shift is expected to increase with an H^2 dependence. It is hoped that the techniques of measurement will be refined sufficiently to detect the deviations from this macroscopic theory which are expected to appear at liquid-helium temperatures.

3212

Washington U. [Dept. of Physics] Seattle.

EFFECTS OF SURFACE CONDITIONS ON THE LINE SHAPE OF FERROMAGNETIC RESONANCE IN METALS (Abstract), by R. L. Cooper, H. B. Silsbee, and E. A. Uehling. [1962] [1]p. [AF 49(638)92] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 448, Aug. 27, 1962.

The width and shape of the ferromagnetic-resonance line in Ni and certain of its alloys have been studied in the 2 cases of static magnetic field parallel or perpendicular to the surface of the sample. Electropolishing or other changes in surface condition can produce large changes in the perpendicular case without corresponding changes in line shape in the parallel case. Annealing has moderate effects which are similar for both cases, except when surface condition is affected by the anneal. Attempts to interpret these observations in terms of current theories of line shape are discussed.

3213

Washington U. [Dept. of Physics] Seattle.

ELECTRON-SPIN-RESONANCE STUDY OF PHASE TRANSITION IN $BaTiO_3$ (Abstract), by W. R. Elliott and J. L. Bjorkstam. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)92] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 449, Aug. 27, 1962.

The Fe^{3+} esr at x-band in $BaTiO_3$ has been used as a vehicle to study the possibility of electric tuning of stimulated-emission devices when a ferroelectric host lattice is employed. There is an abrupt change in the spectrum at both the cubic-tetragonal (120°C) and tetragonal-orthorhombic (0°C) phase transitions. Since these transitions can be induced by applying an electric field to the sample, one should be able to alter appreciably the Fe^{3+} spectrum in this way. Previous attempts to do so have not been successful. Operating at temperatures just above the cubic-tetragonal phase transition in crystals with appropriate impurity concentrations and properly prepared electrodes, the tetragonal field splittings of the Fe^{3+} spectrum with an applied electric field have been induced. Details of these results together with similar studies at the tetragonal-orthorhombic transition are presented.

3214

Washington U. [Dept. of Physics] Seattle.

PROTON RELAXATION AT HIGH TEMPERATURES IN KH_2PO_4-TYPE FERROELECTRIC CRYSTALS (Abstract), by E. A. Uehling, E. D. Jones, and H. B. Silsbee. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)92] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 483, Aug. 27, 1962.

The spin-lattice relaxation time T_1 of spin ½ nuclei in KH_2PO_4 and its isomorphs has been studied in a number of different cases. In all but 1 sample, the experimental data are consistent with expectations based on spin diffusion in the limiting case of slow diffusion. The exception is a particular sample of KH_2AsO_4, presumably of low impurity concentration, in which the proton relaxation times are of the order of 3-5 times longer than in any other sample. It exhibits strong frequency and temperature dependences which are formally consistent with predictions based on spin-diffusion theory in the fast-diffusion limit. This interpretation must be regarded, however, as untenable for reasons which are discussed. The behavior at high frequencies and high temperature suggests a transition from the unknown new mechanism to the competing spin-diffusion mechanism. Additional crystals of sufficiently low impurity concentrations to be useful in these studies are not yet available.

3215

Washington U. [Dept. of Physics] Seattle.

SEARCH FOR THE As^{75} NUCLEAR-MAGNETIC AND QUADRUPOLE RESONANCE IN KH_2AsO_4 (Abstract), by E. D. Jones, H. B. Silsbee, and E. A. Uehling. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)92] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington U., Seattle, Aug. 27-29, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 483, Aug. 27, 1962.

A tentative interpretation of the anomalous behavior of the proton relaxation time T_1 as a function of frequency in the temperature region around the ferroelectric Curie

temperature of KH_2AsO_4 invokes a fast relaxation of the arsenic and an interaction between the arsenic and proton spin systems. Consequently, an extensive search has been made for the As^{75} NMR and NQR. A search for the NMR $\frac{1}{2} \rightarrow \frac{1}{2}$ transition covered the temperature range of 4.2° to 300°K. A search based on a possible quadrupolar splitting was made at 4.2°K (20-90 mc/sec) and at 77°K (5-190 mc/sec). Comparison with previously known quadrupole-resonance signals indicates that the sensitivity of the apparatus is good. All attempts to detect the As^{75} resonance in KH_2AsO_4 have so far failed. Successful observation of the As^{75} NQR in $Na_2HASO_4 \cdot 7H_2O$ has, however, been made. Estimates from sensitivity considerations give an arsenic T_1 not much greater than 10^{-6} sec in KH_2AsO_4.

3216

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

IMMERSIONS OF COMPACT METRIC SPACES INTO EUCLIDEAN SPACES, by S.-T. Hu. [1962] [10]p. (AFOSR-3746) (AF 49(638)179) Unclassified

Also published in Illinois Jour. Math., v. 7: 415-424, Sept. 1963.

By an application of the Smith classes to the tubular neighborhood of the diagonal of the topological square X^2 of a finitely triangulable space X, W.-T. Wu introduced his immersion classes $\Psi^n(X)$ for every n = 1, 2, ... and proved that a necessary condition for X to be immersible into the n-dimensional Euclidean space R^n is $\Psi^n(X) = 0$. By means of this condition, he proved that the n-dimensional skeleton of the unit (m + 2)-simplex cannot be immersed in R^m if $n \leq m \leq 2n - 1$. His method is purely combinatorial, and hence it cannot be extended to general spaces. In a paper on isotopy invariants the enveloping space $E_m(X)$ of any given topological space X for each integer $m > 1$ is defined. If X is finitely triangulable, then $E_m(X)$ has the same homotopy type as the boundary of a tubular neighborhood of the diagonal in the topological power X^m. The objective of the present paper is to apply the Smith theory to $E_m(X)$. This leads to the immersion classes $\Psi_m^n(X)$ defined for every topological space X. If X is a metric space, we consider a subspace $E_m(X, \delta)$ of $E_m(X)$ for every real number $\delta > 0$ and prove that the inclusion $E_m(E, \delta) \subset E_m(X)$ is a homotopy equivalence. This enables us to localize the situation and to establish the main theorem that a necessary condition for a compact metric space X to be immersible into R^n is $\Psi_2^n(X) = 0$. (Math. Rev. abstract)

3217

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

CONFORMAL TRANSFORMATION GROUP OF A COMPACT HOMOGENEOUS RIEMANNIAN MANIFOLD, by S. I. Goldberg and S. Kobayashi. [1962] [4]p. (AFOSR-3254) (AF 49(638)967) Unclassified

Also published in Bull. Amer. Math., v. 68: 378-381, July 1962.

Let M be a Riemannian manifold, $C_0(M)$ the largest connected group of conformal transformations of M, and $I_0(M)$ the largest connected group of isometries of M. The following theorems are announced: (1) Let M be a compact Riemannian manifold. If $C_0(M) \neq I_0(M)$, then there is no harmonic form of degree p, $0 < p < \dim M$, whose length is a non-zero constant, and (2) Let M be a compact homogeneous Riemannian manifold. If $C_0(M) \neq I_0(M)$, then M is a rational homology sphere.

3218

Wayne State U. Dept. of Physics, Detroit, Mich.

MAGNETOACOUSTIC MEASUREMENTS IN THE NOBLE METALS AT 350 MC/SEC, by H. V. Bohm and V. J. Easterling. [1962] [37]p. incl. diagrs. tables, refs. (AFOSR-2760) (AF 49(638)832) AD 295928 Unclassified

Also published in Phys. Rev., v. 128: 1021-1029, Nov. 1, 1962.

Further magnetoacoustic measurements on the noble metals are presented for frequencies up to 350 mc/sec. Plots of the ultrasonic pulse height, h, vs the reciprocal of the magnetic field strength, 1/H, show 20 or more max and min for several orientations in each metal. Fermi surface dimensions are calculated from the periods in 1/H of the magnetoacoustic oscillations using the interpretation that the periodicity arises from those portions of the Fermi surface which are extremal in the q x H direction of momentum space; Fermi surface cross sections viewed along the [100], [110], [111], and [112] directions are shown in detail. The results are compared with Fermi surface dimensions given by: (1) other magnetoacoustic effect data, (2) de Haas-van Alphen and anomalous skin-effect data, and (3) recent band theory calculations. Some simple calculations of electron mean free paths and collision relaxation times are given. (Contractor's abstract)

3219

Wayne State U. Dept. of Physics, Detroit, Mich.

INSTRUMENTATION FOR ULTRASONIC ATTENUATION STUDIES, by G. N. Kamm and H. V. Bohm. [1962] [22]p. incl. illus. diagrs. (AFOSR-2761) (AF 49(638)-832) Unclassified

Also published in Rev. Scient. Instr., v. 33: 957-960, Sept. 1962.

Pulse echo type instrumentation for ultrasonic attenuation studies is described. It incorporates a commercial ultrasonic pulse generator for operation from 10 to 200 mc/sec, and assembled components to extend the range to 350 mc/sec and higher. In addition to the transmitter, receiver, and display components it includes circuits to select and measure the echo pulse and equipment for automatic recording. Details of the circuits and of the sample holder used at 350 mc sec at liquid helium temperatures are presented. (Contractor's abstract)

3220

Wayne State U. Dept. of Physics, Detroit, Mich.

A PROJECT TO STUDY THE ULTRASONIC ATTENUATION IN METAL AT TEMPERATURES NEAR ABSOLUTE ZERO, by H. V. Bohm. Final rept. Feb. 1, 1960-Apr. 30, 1962. June 28, 1962, 7p. incl. refs. (AFOSR-2936) (AF 49(638)832) Unclassified

Ultrasonic attenuation in metals was studied at low temperatures. Some of the topics discussed were: some Fermi surface measurements in silver, ultrasonic attenuation measurements in aluminum, and instrumentation for ultrasonic attenuation studies.

3221

Wayne State U. Dept. of Physics, Detroit, Mich.

342 MC/SEC MAGNETOACOUSTIC MEASUREMENTS IN ALUMINUM, by G. N. Kamm and H. V. Bohm. [1962] [13]p. incl. diagrs. (AF 49(638)832) Unclassified

Published in Proc. Eighth Internat'l. Conf. on Low Temperature Phys., London (Gt. Brit.) (Sept. 16-22, 1962), Washington, Butterworths, 1963, p. 199-201.

Magnetoacoustic oscillations of the ultrasonic attenuation in high-purity single-crystal aluminum samples using 342 mc longitudinal sound waves have been used to make a high resolution study of the surface topology of the Fermi surface. The data verifies the general features of the second-zone Fermi surface proposed by W. A. Harrison, but the dimensions appear to be a few percent larger. The oscillation periods which are observed can be related to central or to off-center orbits on the Fermi surface. An interpretation of the long period oscillations which are observed with magnetic field H in the (100) and (110) planes in comparison with the theoretical model of the third zone Fermi surface is offered.

3222

Wayne State U. Dept. of Physics, Detroit, Mich.

ULTRASONIC ATTENUATION IN SUPERCONDUCTING VANADIUM AND ZINC, by H. V. Bohm and N. H. Horwitz. [1962] [8]p. incl. diagrs. table. (AF 49(638)-832) Unclassified

Also published in Proc. Eighth Internat'l. Conf. on Low Temperature Phys., London (Gt. Brit.) (Sept. 16-22, 1962), Washington, Butterworths, 1963, p. 191-192.

Measurements have been made of the ultrasonic attenuation in single crystal samples of vanadium with longitudinal waves at a frequency 343 mc. The samples had a resistivity ratio of about 130. The fit to adjusted BCS theory values is, in general, quite satisfactory. However, there exists an anisotropy in the values obtained for the energy gap as measured along the 3 major crystallographic directions. Values of 3.4 ± 0.2, 3.1 ± 0.2 and 3.2 ± 0.2 kT_c units were obtained for [110], [100], and [111] directions respectively. Single crystal samples of zinc of 99.9999% purity were examined using longitudinal waves at a frequency of 233 mc. A special cryostat was designed to cool the sample to about 0.4 T_c. Energy gap measurements have been obtained for the [1010] and [1210] crystallographic directions. (Contractor's abstract, modified)

3223

Wayne State U. Dept. of Physics, Detroit, Mich.

ENERGY GAP AND CRITICAL FIELD ON SUPERCONDUCTING MOLYBDENUM OBTAINED BY ULTRASONIC MEASUREMENTS, by N. H. Horwitz and H. V. Bohm. [1962] [2]p. incl. diagrs. (Rept. no. S541) (AFOSR-J104) (AF AFOSR-62-379) AD 400454 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 313-314, Oct. 1, 1962.

A value of 114 ± 5 Oe was found for the critical field at absolute zero and a value of 3.5 ± 0.2 kT_c for the energy gap at absolute zero. for pure molybdenum.

3224

Weizmann Inst. of Science, Rehovoth (Israel).

NMR STUDY OF THE PHOTOLYSIS KINETICS IN SIMPLE AMINO ACIDS. I. SARCOSINE HYDROCHLORIDE AND ITS ESTER, by M. Sheinblatt. [1962] [4]p. incl. diagrs. refs. (AF 61(052)03) Unclassified

Published in Jour. Chem. Phys., v. 36: 3103-3106, June 15, 1962.

The mean lifetimes τ of the amino group of acidic aqueous solutions of sarcosine-HCl and sarcosine Me ester-HCl were measured at 21° by nuclear magnetic resonance techniques. $1/\tau$ was first order in respect to both sarcosine and its ester concentration. $1/\tau$ depended strongly on $1/a_{H^+}$ in very acidic solutions and became almost independent in diluted acid solution. An interpretation is given in terms of an exchange of protons between the amino acid or its ester with a water molecule which was H-bonded to the amino-group.

3225

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

NUMERICAL INTEGRATION OF THE NAVIER-STOKES EQUATIONS, by J. Gillis. Jan. 20, 1962 [39]p. incl. tables, refs. (Technical rept. no. 2) (AFOSR-2236) (AF 61(052)352) AD 274808 Unclassified

The relaxation solution and results obtained for the flow of a viscous fluid in the inlet region of a straight circular pipe at high Reynolds number are described. Analytical and computational work on the Hamel pattern of flow between non-parallel plane walls is also discussed. (Contractor's abstract)

3226

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

1^1S, 2^1S, AND 2^3S STATES OF H^- AND OF HE, by C. L. Pekeris. [1962] [7]p. incl. tables, refs. (AFOSR-3169) (AF 61(052)510) Unclassified

Also published in Phys. Rev., v. 126: 1470-1476, May 15, 1962.

The ionization energy J, including mass-polarization and relativistic corrections but not Lamb shift correction, was evaluated for the 1^1S state of the negative-hydrogen ion using determinants up to order n = 444. We get $J(444) = 6083.0943\ cm^{-1}$, and, by extrapolation, $J(\infty) = 6083.0958\ cm^{-1}$. A search for bound states 2^1S and 2^3S of H^- led to negative results. In the case of helium, an upper bound to the non-relativistic energy eigenvalue ν for the 1^1S state was evaluated at n = 1078 to be $\nu_+ = 198317.866\ cm^{-1}$, as against the previously determined lower bound of $\nu_-(1078) = 198317.374\ cm^{-1}$. For the 2^3S state, this gap is already completely closed at n = 715, with $\nu_+(715) = 38453.1299\ cm^{-1}$ and $\nu_-(715) = 38453.1292\ cm^{-1}$. At n = 1078, $J = 38454.827375\ cm^{-1}$, and the electron charge density at the nucleus D(0) comes out 33.18414092, in agreement with previously extrapolated values. This substantiates a disagreement of the order of one part in 10^5 between theory and experiment in the hyperfine structure of the 2^3S state of He^3 which was established by White, Chow, Drake, and Hughes. With Suh and Zaidi's value for the Lamb shift of $-0.109 \pm 0.009\ cm^{-1}$, the ionization energy of the 2^3S state comes out $38454.718 \pm 0.009\ cm^{-1}$, as against Herzberg's experimental value of $38454.73 \pm 0.05\ cm^{-1}$. For the 2^1S state, we get $J(615) = 32033.316\ cm^{-1}$, which with a Lamb shift of $-0.104 \pm 0.014\ cm^{-1}$ evaluated by Suh and Zaidi, leads to an ionization energy of $32033.214 \pm 0.014\ cm^{-1}$. The experimental value is, according to Herzberg, equal to $32033.26 \pm 0.03\ cm^{-1}$ or at worst, $\pm 0.05\ cm^{-1}$. A summary is given of the verification to date of the Lamb shift in 2-electron atoms. (Contractor's abstract)

3227

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

EXCITED S STATES OF HELIUM, by C. L. Pekeris. [1962] [3]p. incl. tables. [AF 61(052)510] Unclassified

Published in Phys. Rev., v. 127: 509-511, July 15, 1962.

As part of a program aiming to determine all the observed term values of 2 electron atoms on the basis of the Schrodinger wave equation, evaluation has been made of the 1s ns levels of helium up to n = 9, in both the singlet and the triplet states. The previous method, using perimetric coordinates, was extended to allow for the asymmetry between the 1s and the excited electrons. The mass polarization and relativistic corrections were also determined. The difference between the ionization energies J(220), obtained by solving a determinant of order 220, and the experimental values, ranges from $3.6\ cm^{-1}$ for $3\ ^1S$ to $5.8\ cm^{-1}$ for $9\ ^1S$, and from $0.5\ cm^{-1}$ for $3\ ^3S$ to $5.7\ cm^{-1}$ for $9\ ^3S$. The extrapolated values indicate that with a faster computer than WEIZAC it should be feasible to determine all of the 31 observed 1s ns levels ($n \leq 17$) of helium to within the experimental accuracy.

3228

Weizmann Inst. of Science. [Dept.] of Biochemistry, Rehovoth (Israel).

LIGHT-DEPENDENT ADENOSINE TRIPHOSPHATASE IN CHLOROPLASTS, by M. Avron. [1961] [7]p. incl. diagrs. tables, refs. (AFOSR-2895) (AF 61(052)390) Unclassified

Also published in Jour. Biol. Chem., v. 237: 2011-2017, June 1962.

Isolated Swiss chard chloroplasts or chloroplast fragments were shown to possess a light-dependent adenosine triphosphatase (ATPase) activity. The reaction was dependent upon the presence of phenazine methosulphate. It had a pH optimum of approx 8.0, a temperature optimum of 15-20°, and required light intensities of approx 200,000 lux for maximal activity. The reaction was competitively inhibited, strongly by adenosine diphosphate and poorly by adenosine 5'-phosphate. It was also inhibited by magnesium, ammonium, fluoride, arsenate, and ethylenediaminetetraacetate. Calcium markedly stimulated the reaction. In its presence, rates of up to 35 umol of ATP hydrolyzed per mg of chlorophyll per hr were obtained. The possibility that the reaction may reflect a partial reversal of the photophosphorylating path, and its relation to other ATPase reactions, are discussed

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Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

THE MECHANISM OF PHOTOPHOSPHORYLATION IN CHLOROPLASTS, by M. Avron. Final rept. Apr. 30, 1962, 6p. (AFOSR-2950) (AF 61(052)390) AD 283586 Unclassified

The investigation performed concentrated around 4 aspects: (1) Ultraviolet irradiation of chloroplasts. The inhibitory effects of ultraviolet irradiation on photophosphorylation and the Hill reaction was investigated. The mechanism of the inactivation was related to the chloroplastic components which were found to be destroyed by the treatment; (2) Photophosphorylation as a tool for the synthesis of specifically labeled nucleotides; (3) Light activated adenosine triphosphatase; and (4) Reversible uncoupling of photophosphorylation. Treating chloroplasts with ethylenediaminetetraacetate was found to bring about complete uncoupling of the photophosphorylating system. Partial recoupling could be affected by incubation of a 3 component system consisting of: (a) the treated chloroplasts, (b) the components released by the treatment (containing a small amount of protein), and (c) metal ion.

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Weizmann In[illegible] Science. Dept. of Biochemistry, Rehovoth (Israel).

PHOTOPHOSPHORYLATION AS A TOOL FOR THE SYNTHESIS OF SPECIFICALLY LABELED NUCLEOTIDES, by M. Avron. [1961] [9]l. incl. diagrs. tables, refs. (AFOSR-J178) (AF 61(052)390) AD 400458 Unclassified

Also published in Anal. Biochem., v. 2: 535-543, Dec. 1961.

A method is described for the direct synthesis of terminally labeled ATP^{32} with chloroplasts isolated from swiss-chard leaves. By simple variations, both the central and terminal phosphates were equally labeled, or the central phosphate was exclusively labeled. Coupling the reaction with other enzymes is suggested as a mode for the synthesis of many P^{32}-labeled compounds. P^{32}-labeled GTP, ITP, and UTP were also synthesized by the same reaction. All the above compounds may also be synthesized labeled with O^{18} in their phosphate oxygens. The advantages and disadvantages of the method, as compared with others, are discussed.

3231

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

THE EFFECT OF ULTRAVIOLET LIGHT OF PHOTOPHOSPHORYLATION AND THE HILL REACTION, by N. Shavit and M. Avron. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-J947) (AF EOAR-62-59) AD 415927 Unclassified

Also published in Biochem. et Biophys. Acta, v. 66: 187-195, Mar. 1963.

Photophosphorylation and Hill-reaction activity of swiss-chard chloroplasts or chloroplast fragments were decreased by irradiation with short-wavelength ultraviolet light. Photophosphorylation was more resistant to irradiation than the Hill reaction. The presence of ascorbate during irradiation prevented the decrease in Hill reaction and photophosphorylative activity. Protection was more pronounced for the Hill reaction than for photophosphorylative activity. Compounds containing SH-groups could not replace ascorbate; it is suggested that ascorbate protects mostly by reducing the effective ultraviolet intensity, and in addition by exerting a specific effect on the chloroplasts themselves. By ultraviolet irradiation, it was possible to obtain chloroplast preparations which had lost the ability to perform the Hill reaction, but still possessed high photophosphorylative activity. Such preparations may be useful in further research. The endogeneous plastoquinone of chloroplasts was shown to be destroyed by irradiation. The activity of irradiated chloroplasts was stimulated by the addition of plastoquinone. However, a similar stimulation was obtained on addition of plastoquinone to non-irradiated chloroplasts.

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Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

PREPARATION AND CHARACTERIZATION OF POLYTYROSYL TRYPSIN, by A. N. Glazer, A. Bar-Eli, and E. Katchalski. [1962] [7]p. incl. diagrs. tables, refs. (AFOSR-4192) (AF 61(052)391) Unclassified

Also published in Jour. Biol. Chem., v. 237: 1832-1838, June 1962.

Polytyrosyl derivatives containing 20 to 28 additional residues of tyrosine per mol of trypsin were prepared by using trypsin as the initiator for the polymerization of N-carboxy-L-tyrosine anhydride in aqueous solution. Approximately half of the ϵ-amino groups of trypsin were acylated by the N-carboxyanhydride. The average chain length of the tyrosine side chains was approximately 2.5. The polytyrosyl trypsin preparations appeared to be rather homogeneous in the ultracentrifuge. In contrast to trypsin, the polytyrosyl derivative was sparingly soluble between pH 5 and 9. The polytyrosyl trypsin was considerably more resistant to autolysis than the unmodified enzyme. No significant differences were observed in the behavior of polytyrosyl trypsin and trypsin toward denaturing agents such as urea and toward soybean trypsin inhibitor. The polytyrosyl derivatives possessed enzymatic activity toward benzoyl-L-arginine ethyl ester equivalent to that of trypsin. The specific activity of polytyrosyl trypsin toward a variety of ester, protein, and synthetic polypeptide substrates has been determined and compared with that of trypsin. Water insoluble trypsin was prepared from polytyrosyl trypsin, and its activity on low and high molecular weight substrates was tested.

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Weizmann Inst. of Science. [Dept. of Biophysics] Rehovoth (Israel).

INACTIVATION OF ESCHERICHIA COLI BACTERIOPHAGE T2 BY POLY-L-LYSINE. II. PROPERTIES OF THE IRREVERSIBLY INACTIVATED PHAGE, by C. Shalitin and E. Katchalski. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-J951) (Sponsored jointly by Air Force Office of Scientific Research under AF C1(052)391 and National Institutes of Health) AD 416187 Unclassified

Also published in Arch. Biochem. and Biophys., v. 99: 508-516, Dec. 1962.

Coliphage T2 irreversibly inactivated by poly-L-lysine was obtained by prolonged incubation of phage with the basic polypeptide at 37°C, followed by tryptic digestion. T2 particles thus treated, though appearing morphologically intact, have lost their ability to form plaques. Using isotopically labeled (P^{32} or S^{35}) phage, it was demonstrated that T2 inactivated irreversibly by polylysine adsorbs normally to Escherichia coli B, and injects its DNA into the host cells. The adsorption of the irreversibly inactivated phage on E coli B was not accompanied by death of the host cell. In the infected cells, induced biosynthesis of β-galactosidase could be effected. Marker rescue experiments in which $T4r^+$ (wild type), irreversibly inactivated by polylysine, was crossed with intact T4rII, and irreversibly inactivated $T2hr_{22}$ was crossed with intact $T2h^+r^+$ (wild type), revealed that the genome of of the inactivated phage contributes no markers in mixed infections. The same conclusion was drawn from genetic recombination experiments using irreversibly inactivated $T2hr_{22}$ and intact $T2h^+r^+$ (wild type).

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Weizmann Inst. of Science. [Dept. of Biophysics] Rehovoth (Israel).

INACTIVATION OF ESCHERICHIA COLI BACTERIOPHAGE T2 BY POLY-L-LYSINE. I. NATURE OF THE INACTIVATION PROCESS, by C. Shalitin, D. Danon, and E. Katchalski. [1962] [14]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)391 and National Institutes of Health) Unclassified

Published in Arch. Biochem. and Biophys., v. 99: 494-507, Dec. 1962.

Interaction of coliphage T2 with poly-L-lysine was investigated. T2 suspended in saline loses its plaque-forming ability in the presence of polylysine. Inactivation is fast, about 80-90% of phage being inactivated within 1 min, and practically independent of temperature within the range 0-37°C. Study of the effect of pH and ionic strength on the extent of phage inactivation revealed that the interaction between phage and basic polypeptide is largely determined by the electrostatic attraction between the negatively charged virus and the positively charged polypeptide. Partial reversion of the inhibitory effect of poly-L-lysine on the growth of T2 could be carried out by incubation with trypsin or with polyaspartic acid. Populations of coliphage T2 which lost their plaque-forming ability by treatment with polylysine, were thus assumed to consist of 2 fractions: (a) reversibly inactivated phages, i.e., phages whose ability to form plaques is restored by tryptic digestion; and (b) irreversibly inactivated phages, i.e., phages whose ability to form plaques cannot be restored by tryptic digestion. Increase in temperature and time of incubation of T2 with polylysine caused a corresponding increase in the fraction of irreversibly inactivated phage. Electron microscopic examination has shown that inactivation of T2 by polylysine is accompanied by aggregation. Incubation of the phage aggregates with trypsin or with polyaspartic acid resulted in complete resuspension of the agglutinated particles.

3235

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

EFFECT OF A PERIODIC POTENTIAL ON A DEGENERATE FERMI GAS, by S. Moszkowski and L. Wilets. Jan. 18, 1962, 23p. (Technical note no. 14) (AFOSR-2390) (AF 61(052)337) AD 273697 Unclassified

The effect of a periodic potential on the particle and energy density of a degenerate Fermi gas is considered. It is found that for a weak and long wavelength potential the inhomogeneity correction (deviation from the Thomas Fermi statistical model) to the kinetic energy density is only 1/9 as large as the Weizsacker estimate. The potential energy density due to Majorana exchange 2-body interactions of short range is also given to a high accuracy by the statistical model; the corrections are only 1/9 as large as for a short range Wigner (ordinary) interaction. For the analogous 2-dimensional Fermi gas, the inhomogeneity corrections vanish at least to high order unless the periodic potential contains short wavelength components. Relevance to the problem of the nuclear surface is discussed.

3236

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

UNITARY SYMMETRY OF STRONG INTERACTIONS, by C. A. Levinson, H. J. Lipkin, and S. Meshkov. Feb. 15, 1962 [15]p. incl. diagrs. tables. (Technical note no. 15) (AFOSR-2527) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)337 and National Science Foundation) AD 280021 Unclassified

Also published in Phys. Ltrs., v. 1: 44-49, Apr. 15, 1962.

The purpose of this note is to point out various experimental implications of the Octet model and the Sakata model classification schemes for elementary particles. In particular, reaction amplitudes and some of the recently observed resonances are discussed. The methods employed are similar to those used previously, which were concerned with the consequences of the Sakata model. The Octet model as well as the Sakata

model assigns the mesons to a (1, 1) representation of the group SU_3. However the Octet model differs from the Sakata model in the baryon assignments. The Sakata model assigns the n, p and Λ to the (1, 0) symmetry and makes no explicit statements about the remaining baryons. The Octet model assigns the 8 baryons n, p, Λ, Σ^-, Σ^0, Σ^+, Ξ^- and Ξ^0 to thr (1, 1) symmetry.

3237

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

UNITARY SYMMETRY AND NUCLEON-ANTINUCLEON ANNIHILATION, by C. A. Levinson, H. J. Lipkin, and S. Meshkov. Mar. 7, 1962 [5]p. incl. table. (Technical note no. 16) (AFOSR-2697) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)337 and National Science Foundation) AD 280983 Unclassified

Also published in Phys. Ltrs., v. 1: 307-308, July 15, 1962.

Predictions of the ratios of kaon pair production cross sections from nucleon-antinucleon annihilations are made according to both the Sakata and the Octet models.

3238

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

NUCLEAR MANY-BODY PROBLEM WITH NON-UNIFORM DENSITY. I. THEORY, by D. S. Koltun and L. Wilets. [1962] [9]p. incl. refs. [AF 61(052)337] Unclassified

Published in Phys. Rev., v. 129: 880-888, Jan. 15, 1963.

The many-body problem for nuclear matter is considered under the constraint that the density of the system vary periodically in space; this is equivalent to the problem of an external periodic potential. The method of Martin, Schwinger, and Puff is employed to derive, through second order in the amplitude of the density ripple, a set of tractable equations for the energy of the system. No new approximations are needed beyond those already assumed for the uniform density case. The model exhibits some interesting complications of the finite nuclear problem, and yet possesses sufficient simplicity for solubility. In the long-wavelength limit, an expression obtains for the explicit dependence of the energy on the density gradient: this relationship is useful in a study of the nuclear surface problem. Numerical calculations are planned.

3239

Weizmann Inst. of Science. [Dept. of Physics] Rehovoth (Israel).

A REACTION FORBIDDEN BY THE SAKATA MODEL OF UNITARY SYMMETRY, by C. A. Levinson, H. J. Lipkin and others. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61-(052)337] and National Science Foundation) Unclassified

Published in Phys. Ltrs., v. 1: 125, May 1962.

The reaction $p + \bar{p} \rightarrow K_1^0 + K_1^0$ is strictly forbidden according to the Sakata model of unitary symmetry. The observation of this reaction recently reported by the Cern and Collège de France groups is interpreted as evidence against the Sakata model.

3240

Western Ontario U. Dept. of Chemistry, London (Canada).

THE PHOTOCHEMICAL SYNTHESIS OF 1,5-DIKETONES AND THEIR CYCLIZATION: A NEW ANNULATION PROCESS, by P. de Mayo, H. Takeshita, and A. B. M. A. Sattar. [1962] [1]p. incl. diagr. (AFOSR-2164) (AF AFOSR-61-6) Unclassified

Also published in Proc. Chem. Soc. (London): 119, Mar. 1962.

Irradiation 45 hr with an 80-w lamp of a 12% solution of $AcCH_2Ac$ in cyclohexene gave the diketone (78% yield), and this was cyclized by base in 95% yield to a 5:3 mixture (analyzed by gas-liquid chromatography). Similar results were obtained by using cyclopentene, 1-methylcyclohexene, or 1-octene in place of cyclohexene. When isopropenyl acetate was irradiated in the presence of I, and the resulting diketone cyclized with base, AcOH was eliminated with the formation of m-5-xylenol. A mechanism is proposed for both the reactions.

3241

Western Ontario U. Dept. of Chemistry, London (Canada).

THE PHOTODIMERS OF α-PYRIDONES, by W. A. Ayer, R. Hayatsu and others. [1961] [6]p. incl. diagrs. table. (AFOSR-2198) (AF AFOSR-61-6) Unclassified

Also published in Tetrahedron Ltrs. No. 18: 648-653, Nov. 1961.

Lack of high intensity bands at λ 253, 255 mμ (log ε 3.69, 3.73) in the spectrum of α-pyridone dimer (I), its N-Me derivative and other dimers, but present in structures containing the system C: C. N. CO, and lack of a band in the infrared compatible with that expected of a vinyl lactam, excluded the structure proposed and also the 1, 2, 1, 4- Diels-Alder type adduct, but strongly suggested formation by 1, 4-addition of the components themselves. Irradiation of 4-methyl-N- methylpyridone gave a dimer (II), m p 260° (decomposition), doublet 8.15 τ, 1:2 vinyl-methine protons showing the position of the C-Me group on a double bond terminal as a result of 1, 4- addition. Irradiation of 6-methyl-N-methylpyridone gave a dimer (III), m p 210-212° (decomposition), single band at 8.37 τ, 2:1 vinyl-methine protons, indicating the quaternary nature of the Me group. Structures for the dimers were discussed from the standpoint of dipole measurements and nuclear magnetic resonance spectra.

3242

Western Ontario U. Dept. of Chemistry, London (Canada).

THE PHOTO-OXIDATION OF PYRROLE: A SIMPLE SYNTHESIS OF MALEMIDE, by P. de Mayo and S. T. Reid. [1962] [1]p. incl. refs. (AFOSR-3909) (AF AFOSR-61-6) Unclassified

Also published in Chem. and Indus., No. 35: 1576-1577, Sept. 1, 1962.

Photooxidations of pyrroles have, with 2 exceptions, produced tars. Wasserman and Liberles reported interesting products from oxidation of tetrapyrrole, and Bernheim and Morgan obtained from oxidation of pyrrole (I) a crystalline compound which analyzed approx like succinimide, though not it, and gave NH_3 and succinic acid upon alkaline hydrolysis. A 0.1% aqueous solution of I, containing 2.5 mg-% cosin, shaken and irradiated with a 100-w lamp rapidly took up 1 mol of O. Evaporation of the solvent at room temperature, extraction of the residue with Me_2CO, and crystallization from the same gave the hydroxyketopyrolidine II (R = H), m.p. 102-2.5° (32%). Infrared bands at 1650 and 1590 cm^{-1} supported structure II. Similar oxidation of N-methylpyrrole gave II (R = Me), m.p. 84-5° (48%). Contratry to the report of Bernheim and Morgan, this oxidation proceeded to the same extent and at about the same rate as that of I.

3243

Western Ontario U. Dept. of Chemistry, London (Canada).

PHOTOCHEMICAL SYNTHESES, 5. SULPHENES AND PHOTOCHEMICAL INTERMEDIATES, by J. P. King, P. de Mayo and others. [1962] [8]p. incl. diagrs. table, refs. (AFOSR-J242) (AF AFOSR-61-6) AD 400847 Unclassified

Also published in Canad. Jour. Chem., v. 41: 100-107, Jan. 1963.

The present status of sulphenes ($R'R''C:SO_2$) as stable entities or chemical intermediates is discussed. The early report by Locher and Fierz (Helv. Chim. Acta, v. 10: 642, 1927) of the preparation of a stable crystalline sulphene has been investigated; it is concluded that their claim is unfounded. The irradiation of unsaturated sultones in the presence of methanol is shown to give sulphonic esters: the corresponding thermal reaction of sultones is known to lead to sulphonic acid derivatives. It is proposed that the irradiation of unsaturated sultones yields sulphenes, which then react with the medium. (Contractor's abstract)

3244

Western Ontario U. Dept. of Chemistry, London (Canada).

PHOTOCHEMICAL SYNTHESIS. 6. THE FORMATION OF HEPTANDIONES FROM ACETYLACETONE AND ALKENES, by P. de Mayo and H. Takeshita. [1962] [10]p. incl. diagrs. refs. (AFOSR-J281) (AF AFOSR-61-6) AD 400848 Unclassified

Also published in Canad. Jour. Chem., v. 41: 440-442, Feb. 1963.

The irradiation of acetylacetone in the presence of oct-1-ene, cyclopentene, cyclohexene, and 1-methylcyclohexene gives substituted heptandiones. These diketones may then be cyclized with acid or base. Irradiation of isopropenyl acetate and acetylacetone gives, after cyclization, m-5-xylenol. The mechanism of the reaction is discussed: it represents the first cyclo-addition to an isolated ethylenic linkage. (Contractor's abstract)

3245

Western Ontario U. Dept. of Physics, London (Canada).

ALLOWED TRANSITIONS, by R. W. Nicholls and A. L. Stewart. [1962] [32]p. incl. diagrs. tables, refs. (AFOSR-J107) (AF AFOSR-61-88) AD 400463 Unclassified

Also published in Atomic and Molecular Processes, ed. by D. R. Bates, Academic Press, New York, 1962, p. 47-78.

Atomic and molecular line strength calculation methods are explained, and transition probability measurements are discussed.

3246

Western Ontario U. Dept. of Physics, London (Canada).

CONDON PARABOLAE IN MOLECULAR SPECTRA, by R. W. Nicholls. 1962, 2p. (AFOSR-J117) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-68, National Research Council of Canada, and Ontario Research Council) AD 400195 Unclassified

Also published in Nature, v. 193: 966-967, Mar. 10, 1962.

A simple derivation of the Franck-Condon locus is discussed. This is based on a knowledge of molecular potentials and their vibrational energy levels. This problem is not only of academic interest but also has practical applications in the identification and location of new strong bands which lie on the locus.

3247

Western Ontario U. [Dept. of Physics] London (Canada).

THE EFFECT OF DISCHARGE CONDITIONS ON THE INTENSITY OF THE NITROGEN SECOND POSITIVE SYSTEM (Abstract), by D. C. Tyte. [1962] [1]p. (AFOSR-5065) (AF AFOSR-62-236) Unclassified

Presented at meeting of the Canadian Association of Physicists, Laval U., Quebec City (Canada), June 6-9 [1962].

The relative intensities of the nitrogen second positive system have been measured in a discharge through nitrogen under a wide range of current densities and in a discharge through a wide range of helium-nitrogen mixtures.

Results indicate a small systematic variation with conditions of the intensity ratio of bands from a common upper state. It is suggested that this is an indication that the molecule may be slightly distorted by the fields existing in the discharge plasma.

3248

Western Ontario U. [Dept. of Physics] London (Canada).

GEOMETRICAL CONSIDERATIONS OF CONDON LOCI OF MOLECULAR SPECTRA (Abstract), by R. W. Nicholls. [1962] [1]p. (AFOSR-5006) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-236 and National Research Council of Canada) Unclassified

Presented at meeting of the Canadian Association of Physicists, Laval U., Quebec City (Canada), June 6-9 [1962].

The geometry (in the v', v'' plane) of primary and subsidiary Condon loci of relatively intense bands in molecular spectra is discussed for a number of molecular potentials.

3249

Western Ontario U. [Dept. of Physics] London (Canada).

THE LUMINESCENCE PRODUCED BY PROTON BOMBARDMENT (40-30 KEV) OF NITROGEN (Abstract), by R. P. Lowe and H. I. S. Ferguson. [1962] [1]p. (AFOSR-5007) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-236 and National Research Council of Canada) Unclassified

Presented at meeting of the Canadian Association of Physicists, Laval U., Quebec City (Canada), June 6-9 [1962].

Spectral features due to H, NII, N_2 and N_2^+ have been produced using a 40-30 kev proton beam in nitrogen. The variations of intensity with pressure lead to a better understanding of the collision processes giving rise to the radiation. Such data is required for the interpretation of the spectra of certain types of aurora.

3250

Western Ontario U. [Dept. of Physics] London (Canada).

A SPECTROSCOPIC STUDY OF LIGHT FROM THE X-RADIOLYSIS OF SIMPLE GASES (Abstract), by I. S. Lee, R. W. Nicholls, and H. I. S. Ferguson. [1962] [1]p. (AFOSR-5008) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-236, National Aeronautics and Space Administration, and Department of Defence Production of Canada) Unclassified

Presented at meeting of the Canadian Association of Physicists, Laval U., Quebec City (Canada), June 6-9 [1962].

The fluorescent yield of gases is an important radiochemical quantity. Qualitative and quantitative observations have been made on the spectral features of the optical fluorescence excited by 50 kv x-rays in air, N_2, O_2, CO_2, H_2, and Ar.

3251

Western Ontario U. [Dept. of Physics] London (Canada).

SPECTROSCOPIC OBSERVATIONS ON THE IMPACT FLASH PHENOMENON IN A PELLET RANGE (Abstract). by R. A. Koehler and R. W. Nicholls. [1962] [1]p. (AFOSR-5009) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-236 and Department of Defence Production of Canada) Unclassified

Presented at meeting of the Canadian Association of Physicists, Laval U., Quebec City (Canada), June 6-9 [1962].

The impact flash is the light emitted for about a μsec at the impact of high speed (4000 ft/sec) pellets on a solid. Recent optical and spectroscopic observations on the impact flash from lead on lead is described and a discussion made of the probable physical processes involved.

3252

Western Ontario U. Dept. of Physics, London (Canada).

LABORATORY ASTROPHYSICS, by R. W. Nicholls. [1962] [22]p. incl. diagrs. tables, refs. (AFOSR-J222) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under AF AFOSR-62-236, Department of Defence Production of Canada, National Research Council of Canada, and Office of Naval Research) AD 299880 Unclassified

Presented at First internat'l. Conf. on Vacuum Ultra-Violet Radiation Physics, Los Angeles, Calif., Apr. 16-19, 1962.

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 433-449, Oct./Dec. 1962.

The great need for laboratory work on astrophysical problems is discussed and illustrated by the current research program in this field at the University of Western Ontario. As an example of the experimental work in progress, a critical review is given of intensity measurements on 20 band systems. The dependence upon transition parameters of the degree of variation of the electronic transition moments for these systems is discussed. The variation with internuclear separation of the electronic perturbation integral in excitation and ionization transitions is also discussed. As an example of the theoretical work in progress, arrays of Franck-Condon factors calculated to high vibrational quantum numbers for the following 11 vacuum ultraviolet band systems and 9 excitation transitions are presented: (1) N_2: Lyman-Birge-Hopfield, Vegard-Kaplan, Birge-Hopfield; (2) N_2^+: Janin d'Incan, Second Negative; (3) O_2: Schumann-Runge; (4) CO: Fourth Positive, Cameron, Hopfield-Birge a, Hopfield-Birge b; (5) CO^+: First Negative; (6) $N_2(X^1\Sigma_g^+) - N_2(a^1\Pi_g$,

$A^3\Sigma_g$, $B^3\Pi_g$, $C^3\Pi_u$); and (7) $N_2(X^1\Sigma_g^+) - N_2^+$ ($X^2\Sigma_g^+$, $A^2\Pi_u$, $B^2\Sigma_u$, $?^2\Pi_g$, $C^2\Sigma$). Finally a study of the geometry in the v'-v'' plane of loci of the local maxima of Franck-Condon factors is reviewed. This has immediate application to identification of molecular spectra.

3253

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS AND r-CENTROIDS TO HIGH VIBRATIONAL QUANTUM NUMBERS FOR THREE BAND SYSTEMS OF CO^+ AND ABSOLUTE BAND STRENGTHS FOR THE COMET-TAIL SYSTEM, by R. W. Nicholls. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-3223) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-236, Department of Defence Production of Canada, National Research Council of Canada, Office of Naval Research, and Ontario Research Council) AD 400442 Unclassified

Also published in Canad. Jour. Phys., v. 40: 1772-1783, Dec. 1932.

Franck-Condon factor and r-centroid arrays computed to high vibrational quantum numbers for Morse potentials are displayed for the CO^+ comettail ($A^2\Pi_i$-$X^2\Sigma^+$), first negative ($B^2\Sigma^+$–$X^2\Sigma^+$), and Baldet-Johnson ($B^2\Sigma^+$–$A^2\Pi_i$) band systems. Estimates of band strengths are made for CO^+ comet-tail bands, (Contractor's abstract)

3254

Western Ontario U. Dept. of Physics, London (Canada).

EINSTEIN A COEFFICIENTS, OSCILLATOR STRENGTHS AND ABSOLUTE BAND STRENGTHS FOR THE N_2 SECOND POSITIVE AND N_2^+ FIRST NEGATIVE SYSTEMS. by R. W. Nicholls. [1962] [4]p. incl. tables. (AFOSR-J758) (AF AFOSR-62-236) AD 414043 Unclassified

Also published in Jour. Atmos. and Terrest. Phys., v. 25: 218-221, Apr. 1963.

The need for absolute transition probability data for atomic and molecular spectra which are important in atmospheric physics and astrophysics has stimulated experimental and theoretical work in a number of laboratories. In this note relative intensity measurements on bands of the N_2^+ first negative and N_2 second positive systems and vibrational lifetime measurements for the upper states of these systems are used to derive the 3 absolute transition probability parameters: Einstein A coefficient band oscillator strength and band strength for all accessible bands of the systems.

3255

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTOR SURFACE FOR THE $I_2(B^3\Pi_{0u^+} - X^1\Sigma_g^+)$ BAND SYSTEM, by R. W. Nicholls. [1962] [2]p. incl. diagr. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-236, National Research Council of Canada, Office of Naval Research, and Ontario Research Foundation) Unclassified

Published in Jour. Chem. Phys., v. 38: 1029-1030, Feb. 15, 1963.

A representation is given of the 3 dimensional Franck-Condon factor surface in the range $0 < v' < 30$; $0 < v'' < 40$.

3256

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS FROM KLEIN-DUNHAM POTENTIALS FOR BANDS OF THE SCHUMANN-RUNGE SYSTEM OF O_2, by W. R. Jarmain. [1962] [3]p. incl. tables, refs. (Sponsored jointly by Air Force Cambridge Research Center; Air Force Office of Scientific Research under AF AFOSR-62-236, Department of Defence Production of Canada, National Research Council of Canada, and Office of Naval Research) Unclassified

Published in Canad. Jour. Phys., v. 41: 414-416, Feb. 1963.

Preliminary Franck-Condon factors for the Schumann-Runge system of O_2, based on Klein-Dunham potentials, are reported and compared with those obtained using the Morse function.

3257

Western Ontario U. Dept. of Physics, London (Canada).

PHOTOELECTRIC INTENSITY MEASUREMENTS UPON BANDS OF THE SiN ($B^2\Sigma^+$–$X^2\Sigma^+$) SPECTRUM, by A. E. Stevens and H. I. S. Ferguson. [1962] [6]p. incl diagrs. table, refs. (Sponsored jointly by Air Force Cambridge Research Center; Air Force Office of Scientific Research under AF AFOSR-62-236, Department of Defence Production of Canada, National Research Council of Canada, Office of Naval Research, and Ontario Research Foundation) Unclassified

Published in Canad. Jour. Phys., v. 41: 240-245, Feb. 1963.

The SiN $B^2\Sigma^+$–$X^2\Sigma^+$ (3600-5200A) spectrum was excited by continuous introduction of $SiCl_4$ in trace amounts into the afterglow produced by microwave excitation of nitrogen. Relative intensities of 21 bands were measured photoelectrically and interpreted with the aid of Franck-Condon factors $q_{v',v''}$ in terms of the variation of the

electronic transition moment $R_e(r)$ with internuclear separation r. It was found that $R_e(r)$ could be represented empirically by $R_e(r) = \text{const.}\ (1 - 1.27r + 0.412r^2)$, $1.38 \leq r \leq 1.17$A. (Contractor's abstract)

3258

Western Reserve U. Dept. of Physics, Cleveland, Ohio.

FURTHER COMMENTS ON ACCIDENTAL COINCIDENCES IN FAST-SLOW COINCIDENCE SYSTEMS, by E. B. Shera. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)61] and National Science Foundation) Unclassified

Published in Nucl. Instr. and Methods, v. 12: 198, June 1961.

The assumption of independence in regard to a 2-fold fast-slow coincidence circuit leads to the omission of a term due to the finite resolving time of the fast coincidence circuit: $N^{12} = 2t_f N_1 N_2$, where $2t_f$ is the resolving time of the fast coincidence circuit and N_1, N_2 are the counting rates from the amplitude selectors. This term represents a major contribution to the actual random rate in most experiments. When estimating the magnitudes of the remaining accidental terms, the effect of dead times in the detectors and in the electronic circuitry before the slow coincidence circuit should not be neglected. These terms represent processes in which 2 successive events occur in the same detector within the resolving time of the slow coincidence circuit. If the detector or circuitry is inoperative for an interval following an event, the accidental counting rate from such processes will be correspondingly reduced. Indeed, if the dead time of the detectors is longer than the resolving time of the slow coincidence circuit, these processes contribute nothing to the random rate.

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Western Reserve U. [Dept. of Physics] Cleveland, Ohio.

MEAN LIVES OF POSITRONS IN AQUEOUS SOLUTIONS, by J. E. Jackson and J. D. McGervey. [1962] [12]p. incl. diagrs. table. (AFOSR-3541) (AF 49(638)760) AD 286919 Unclassified

Also published in Jour. Chem. Phys., v. 38: 300-303, Jan. 15, 1963.

By measurement of the time distribution of positron annihilations in aqueous solutions, reaction rates for oxidation of positronium by the ions MnO_4^-, IO_3^-, and Hg^{++} have been determined. In strong oxidizing solutions the mean life of the positrons reaches a lower limit of 4.3×10^{-10} sec; the short lifetime τ_1 in water was measured and found to agree with this value. A $Pb(ClO_4)_2 \cdot 3H_2O$ solution reduced the intensity I_2 with no significant change in the long life τ_2, an effect previously observed in nitrate solutions. This may mean that in these 2 cases oxidation can occur before Ps is thermalized but not afterwards. The decay distributions from a mixture of Hg^{++} and MnO_4^- ions in solution and the Hg^{++} ion in separate solutions with Cl^- and ClO_4^- indicated an association taking place between the negative and positive ions. (Contractor's abstract)

3260

Western Reserve U. [Dept. of Physics] Cleveland, Ohio.

POSITRON ANNIHILATION REACTIONS IN CONDENSED MATERIALS, by J. D. McGervey. Final rept. July 1, 1960-June 30, 1962 [7]p. incl. diagrs. (AFOSR-3542) (AF 49(638)760) AD 286667 Unclassified

Measurements were made of the time distribution of positron annihilations in aluminum, tin, copper, titanium, and zinc. All of these metals measured to date have shown a long lived component. This component, which is still unexplained, contains from 5 to 10% of the total counts, with a mean life of about 4×10^{-10} sec in all the metals measured. The presence of the long lived component is deduced from an extremely small number of counts. Nevertheless these counts are significantly above the background level; the counting rate in the peak was about 5000 times the background. Short mean lives in these metals were determined by subtracting the counts in the extrapolated long lived component and measuring the slope of the remaining distribution. Data are being obtained on the angular distribution of annihilation radiation from alloys. The angular correlation method gives a direct experimental determination of the Fermi energy of the conduction electrons. The major difficulty with the method is that in many alloys of interest a large number of positrons annihilate with core electrons rather than conduction electrons, and it is necessary to subtract this component in order to obtain the curve for conduction electron annihilation. (Contractor's abstract)

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Western Reserve U. [Dept. of Physics] Cleveland, Ohio.

CONTACT POTENTIAL OF CADMIUM SULFIDE, by J. C. Erskine and S. Machlup. [1962] 12p. incl. diagrs. [AF 49(638)760] Unclassified

Presented at meeting of the Amer. Phys. Soc., Toledo, Ohio, May 4-5, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 586, Nov. 23, 1962.

The Kelvin method has been used to measure the contact potential between a c-cut CdS crystal (both +c and -c faces) and a reference (platinum or gold) electrode. The Brattain-Bardeen cycle of ambient gases gave poor reproducibility; and $N_2 - H_2S - N_2 - SO_2$ cycle became reliable after 2 or 3 cycles, giving a difference of surface potentials of about 50 mv (the matte -c surface more electropositive than the shiny +c). After 4 or 5 cycles, the contact potential (relative to Pt) of both surfaces varied between 0.4 and 0.5 v. The potentials approached each other after repeated cycling (producing visible

deposits of sulfur on the -c face). These results are in qualitative agreement with predictions based on piezoelectric, x-ray diffraction, and solution potential data for II-VI compounds having wurtzite structure.

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Western Reserve U. [Dept. of Physics] Cleveland, Ohio.

OXIDATION OF POSITRONIUM (Abstract), by J. E. Jackson and J. D. McGervey. [1962] [1]p. [AF 49(638)-760] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 337, Apr. 23, 1962.

The oxidation of Ps has been observed in the oxidizing solutions $KMnO_4$, KIO_3, and $HgCl_2$. The variation of the long mean life with concentration shows that the oxidation probability per unit time is proportional to the concentration of the oxidizing ions (MnO_4^-, IO_3^-, and Hg^{2+}). The short mean life in water was measured and found to be $(0.41 \pm 0.03) \times 10^{-9}$ sec. equal to the "long" mean life in highly concentrated solutions, as expected. The oxidation rate for various ions, negative as well as positive, depends on their chemical-oxidation potentials. It was found that in solutions of $Pb(ClO_4)_2 \cdot 3H_2O$ the intensity of the long-lived component decreased with no measurable change in the long lifetime itself. A similar result was obtained for $NaNO_3$ solutions by Green and Bell. The oxidation potential of Pb^{2+} is close to that of NO_3^-, and is smaller than that of the other oxidizing ions; thus, it may be that in these solutions positronium can be oxidized before it is thermalized, but not afterwards.

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Western Reserve U. School of Library Science, Cleveland, Ohio.

TEST PROGRAM FOR EVALUATING PROCEDURES FOR THE EXPLOITATION OF LITERATURE OF INTEREST TO METALLURGISTS. V. THE SEMANTIC CODE TODAY, by J. L. Melton. [1962] [90]p. incl. diagrs. tables. (AFOSR-1210) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)357 and National Science Foundation) AD 263126 Unclassified

Also published in Amer. Doc., v. 13: 176-181, Apr. 1962.

For abstract see item no. 3133, Vol. V.

3264

Western Reserve U. [School of Library Science] Cleveland, Ohio.

THEORY OF DOCUMENTATION AND SEARCHING STRATEGY. Final technical documentary rept. [1962] 41p. incl. refs. (AFOSR 2710) (AF 49(638)357) AD 278551 Unclassified

A report is made of work directed toward the development of a general theory of documentation which will enable mathematical analyses of the basic principles underlying techniques of information retrieval. Two basic lines have been followed in these studies. The first is that of investigating existing information systems, analyzing and comparing them in such a way as to provide data upon which hypotheses may be tested. This may be referred to as the "practical" approach. The second is that of mathematical and logical investigation of documentation in the abstract, developing the models and the hypotheses which are to be used in working toward a general documentation theory; this is referred to as the "theoretical" approach. The practical approach has been followed in the study of devices, procedures, and operations used in information retrieval. The theoretical approach has been applied to studies in systems and operations analyses. Citations with abstracts are given for 30 publications resulting from these studies.

3265

Western Reserve U. [School of Library Science] Cleveland, Ohio.

INFORMATION RETRIEVAL ON THE GE-225 COMPUTER, by J. Belzer. [1962] [9]p. incl. diagrs. [AF 49(638)357] Unclassified

Published in Information Retrieval in Action; Proc. of a Conf., Western Reserve U., Cleveland, Ohio (Apr. 16-18, 1962), Cleveland, Western Reserve U. Press, 1963, p. 31-39.

In an automatic retrieval system there are two important parameters: the efficiency of the system, and the effectiveness of the system. The efficiency of the system depends on the computer technique in performing the searches rapidly. This is accomplished by scoring the terms in the documents which are required in the questions and thus by-passing the need for comparisons of each term in the question with each of the terms in the documents. Also, for reasons of efficiency the sytem yields document numbers only, as answers to questions. The effectiveness is accomplished by great depth in document analysis and indexing its content by concept rather than words. This approach requires a sequential type system rather than the aspect type.

3266

Western Reserve U. School of Library Science, Cleveland, Ohio.

"NEED-TO-KNOW", by A. J. Goldwyn. [1962] [4]p. incl. illus. (AF 49(638)357) Unclassified

Published in Library Jour., v. 87: 1351-1354, Apr. 1, 1962.

The operator of an information system must establish and maintain a control over the use of this file. "Need

to Know" is used here to designate a formal test designed to protect this control. From the user's point of view, such a test, if arbitrarily set, may be unfair if it denies to him the right of access to a needful product. Some tests are implicit in the nature of any system: these include a corporate or governmental right to restrict access to certain information. Beyond this, however, the operator can ask that the question be answerable, that it be based on a real need, and that it be expressed in appropriately formulated terms.

3267

Western Reserve U. [School of Library Science] Cleveland, Ohio.

PERTINENCY OF SEARCH RESULTS TO COMPUTER OUTPUT, by J. L. Melton. [1962] [9]p. [AF 49(638)-357] Unclassified

Published in Information Retrieval in Action; Proc. of a Conf., Western Reserve U., Cleveland, Ohio (Apr. 16-18, 1962), Cleveland, Western Reserve U. Press, 1963, p. 161-169.

The determination of pertinence of search result in relation to computer output is extremely difficult. Even though the computer output may be completely relevant to a question, the component information elements are not likely to be equally useful. Some of the problems to be considered are the environment of the question, the background and needs of the questioner, and the order of presentation of the information elements.

3268

Western Reserve U. [School of Library Science] Cleveland, Ohio.

PROBABILISTIC MODELS IN INFORMATION RETRIEVAL, by W. Goffman. [1962] [6]p. [AF 49(638)357] Unclassified

Published in Information Retrieval in Action; Proc. of a Conf., Western Reserve U., Cleveland, Ohio (Apr. 16-18, 1962), Cleveland, Western Reserve U. Press, 1963, p. 155-130.

After some preliminary remarks on mathematical models in general, a model of an information retrieval system is developed based on certain assumptions and leading to first and second approximations of the optimal answer.

3269

Western Reserve U. School of Library Science, Cleveland, Ohio.

SIMILARITY AND STABILITY OF TEXTUAL INTERESTS, by R. A. Fairthorne. [1962] [15]p. [AF 49(638)357] Unclassified

Published in Information Retrieval in Action; Proc. of a Conf., Western Reserve U., Cleveland, Ohio (Apr. 16-18, 1962), Cleveland, Western Reserve U. Press, 1963, p. 183-197.

Useful grouping of texts depends on the stability of interests of the users. Since the task of the documentalist is to supply a particular person with a particular text, theory must begin to work in terms of particular people and places, with the result that the methods and materials of documentation are inherently imprecise and incomplete The first task of mathematics in this situation is not to use more powerful methods to refine results, but to represent what are deemed to be the essential formal documentary characteristics. In this application, constructivist mathematics will probably prove most useful.

3270

Western Reserve U. School of Medicine, Cleveland, Ohio.

SPINAL CORD AND ACTH RELEASE IN ADRENALECTOMIZED RATS FOLLOWING ELECTRICAL STIMULATION, by E. S. Redgate and N. D. Lipscomb. [1961] [4]p. incl. tables, refs. (AFOSR-1647) (AF 49(638)443) Unclassified

Also published in Endocrinology, v. 70: 263-266, Feb. 1962.

Rapid ACTH release following stimulation of an extremity has been proposed to occur by mediation through vascular and neural paths. The vascular paths presumably involve release of substances into the blood at the site of stimulation which subsequently release ACTH from the pituitary. Blood ACTH levels in adrenalectomized rats were measured by the adrenal ascorbic acid method in hypophysectomized rats. The contribution of the vascular path to the mediation of ACTH release was estimated by assaying aortic blood for ACTH content after electrical stimulation of the hindlegs of 3-hr and 48-hr cord-sectioned rats. No response to the flow of electric current through the hindlegs was observed. It was concluded that no contribution to ACTH release was rendered by the vascular path. In contrast, electrical stimulation of the intact neural paths in the forelegs of cord-sectioned rats resulted in ACTH release equivalent to that observed in intact cord rats. This indicated that absence of ACTH release in response to hindleg stimulation was not the result of depression of ACTH release in the cord-sectioned adrenalectomized rat preparations.

3271

Western Reserve U. School of Medicine, Cleveland, Ohio.

SPINAL CORD AND ACTH RELEASE IN ADRENAX RATS, by E. S. Redgate. Oct. 1961 [10]p. incl. tables. (AFOSR-1651) (AF 49(638)443) Unclassified

The task of delineating the pathways by which ACTH release is mediated is hindered by the tremendous variety of stimul which induce ACTH release. Investigators have proposed mediation by neural pathways and by chemical factors. To assess the relative ACTH releasing effectiveness of neural and vascular paths, the thoracic cord-sectioned rat was chosen. The

effectiveness of the vascular path from periphery to pituitary was tested by measuring ACTH release attendant upon hindpaw stimulation, while the neural path effectiveness could be estimated in cord-sectioned rats by stimulation of the normally innervated forepaws. Previously the data supported the conclusion that spinal paths are essential while there was no support for a blood-borne chemical mediator originating at the site of stimulation. ACTH depression was considered in detail and lead accidently to the observation that fasted rats respond with elevated blood levels of ACTH which are significantly above those of the fed rats.

3272

Western Reserve U. School of Medicine, Cleveland, Ohio.

MEDIATION OF ACTH RELEASE BY STRUCTURES IN ISOLATED CAT BRAIN. by E. S. Redgate. Oct. 1961 [6]p. incl. tables. (AFOSR-1652) (AF 49(638)443) Unclassified

The available data suggests that posterior hypothalamic and midbrain neurons increase ACTH output while hippocampal, anterior hypothalamus, and cortex inhibit ACTH output. The present experiments are concerned with testing the affect of these neural structures on ACTH output from the isolated brain cat preparation which is elicited by electrical stimulation. The choice of this preparation was dictated by 2 primary considerations: neurophysiological procedures such as stimulation and ablation can be carried out in the absence of interference of secondary effects mediated by neural paths to periphery; and the procedures can be carried out in the absence of anesthesia. The carotid sinuses were denervated, nodose and superior cervical ganglia extirpated. Recording electrodes were placed on the lateral gyrus and the middle ectosylvian gyrus. A stimulating electrode was placed at various sites in the midbrain and pons. The spinal cord was sectioned at the C-1 level and ether anesthesia discontinued Positive pressure respiration was instituted with 5% CO_2, 95% O_2. Since blood from the anterior cavernous sinuses as well as many other structures in the head drain through the posterior facial vein, this blood was collected for ACTH assay. Tegmental stimulation at sites capable of evoking typical arousal responses is associated [illegible]reased ACTH output. Stimulation at other site[illegible]ebral peduncles is associated with neither a[illegible]CTH release.

3273

Western Reserve U. School of Medicine, Cleveland, Ohio.

VASOPRESSIN BIOSYNTHESIS, II. INCORPORATION OF [^{35}S]CYSTEINE INTO VASOPRESSIN AND PROTEIN ASSOCIATED WITH CELL FRACTIONS, by H. Sachs. [1962] [13]p. incl. diagrs. tables, refs. (AFOSR-J835) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)764 and National Institutes of Health) AD 416517 Unclassified

Also published in Jour. Neurochem., v. 10: 299-311, May 1963.

Following the direct infusion of highly labeled [S^{35}]cysteine into the third ventricle of the brain of the dog, it was possible to isolate minute quantities (0.06 to 2.0 μg) of [S^{35}]vasopressin associated with a number of cellular structures. The isotopic purity of each labeled vasopressin fraction was confirmed by extensive ion exchange chromatography and degradative procedures. After the continuous infusion of [S^{35}]cysteine for 3-6 hr, vasopressin associated with the neurosecretory particles always had the lowest specific activity. Vasopressin molecules with high specific activities were associated with 2 particulate fractions; namely, the crude hypothalamic nuclear fraction (600 g, 15 min) and a large-granule fraction (10,500 g, 15 min). Further fractionation of the large-granule and microsome fraction with deoxycholate indicated that vasopressin with the highest specific activity was associated with the membranous (deoxycholate soluble) components rather than with the ribosome rich fraction. In contrast to the incorporation of [S^{35}]cysteine into vasopressin, the proteins with the highest specific activity were found in the fraction containing the neurosecretory particles. When [H^3]leucine was infused into the third ventricle instead of [S^{35}]cysteine, the proteins associated with the microsomal fraction had the highest specific activity.

3274

Western Reserve U. School of Medicine, Cleveland, Ohio.

STUDIES ON THE INTRACELLULAR DISTRIBUTION OF VASOPRESSIN, by H. Sachs. [1962] [9]p. incl. diagrs. tables, refs. (AFOSR-J836) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)764 and National Institutes of Health) AD 416518 Unclassified

Also published in Jour. Neurochem., v. 10: 289-297, May 1963.

Homogenates of dog hypothalamo-median eminence (HME) were centrifuged to remove nuclei and cell debris. The 70,000 g pellet from this supernatant contained 40-50% of the vasopressin activity and was rich in neurosecretory particles (NSP). The NSP fraction from HME contained only 20% of the vasopressin content of neural lobe NSP fraction. Vasopressin in NSP could be concentrated 5-fold by centrifugation in a sucrose gradient. Subcellular distribution of protein, nucleic acid, cytochrome oxidase and β-glucuronidase were also studied but no correlation could be made with vasopressin distribution.

3275

Western Reserve U. School of Medicine, Cleveland, Ohio.

ACTH IN DOG BLOOD (Abstract), by N. Ohsawa and E. S. Redgate. [1962] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-3, and Public Health Service) Unclassified

Presented at Fall meeting of the Amer. Physiol. Soc., Buffalo U., N. Y., Aug. 28-31, 1962.

Published in The Physiologist, v. 5: 191, Aug. 1962.

Dog plasma, incubated 12 to 16 hr at 370°C, contained no detectable quantity of ACTH. U.S.P. Reference Standard was added, the plasma dissolved in 5% acetic acid and heated to 70°C for 30 min. The solution was applied to an XE-64 resin column. ACTH was eluted with 50% acetic acid and the eluant lyophilized. The dry powder was dissolved in acid-saline (0.01 N HCl in 0.9% NaCl) and assayed in hypophysectomized rats by the adrenal ascorbic acid depletion method. When compared with Reference Standard dissolved in acid-saline, recovery was 145% (mean of five experiments). Dog plasma was processed as described above and ACTH added to the lyophilized eluant. Potency was 180% as compared to ACTH in acid-saline. ACTH added to unprocessed dog plasma or to bovine serum albumin (Fraction V) was more potent than ACTH in acid-saline (160 and 180%, respectively). When corrected for "potentiation", recovery by the XE-64 method is about 80%. By this method, blood ACTH levels in dogs under deep pentobarbital anesthesia have been shown to range between less than 1.5 to 7.5 milliunits for 100 ml whole blood. The elevation in the level of ACTH in blood from the carotid artery, induced by hemorrhage, was unexpectedly as great as that in blood from the jugular vein.

3276

Westinghouse Electric Corp. [Air Arm Div.] Baltimore, Md.

THREE DIMENSIONAL ORBITS WITH FIXED LOW THRUST, by G. Shapiro. May 11, 1962, 10p. (AFOSR-2610) (AF 49(638)1002) AD 276684 Unclassified

The orbit of a satellite with an additional fixed low thrust in a fixed direction is extended to 3 dimensions. The orbital eccentricity and inclination oscillate between bounds independent of the low thrust level. Escape does not occur and the major axis remains constant. The applicability of the analysis to the behavior of the orbit of a satellite for solar observation is shown. (Contractor's abstract)

3277

Westinghouse Electric Corp. Air Arm Div., Baltimore, Md.

ANALYTIC SOLUTION OF A MICROTHRUST PROBLEM, by G. Shapiro and E. W. Paul. [1962] [19]p. (AFOSR-4336) (AF 49(638)1002) AD 293204 Unclassified

Presented at Seventeenth annual Meeting and Space Flight Exposition of the Amer. Rocket Soc., Los Angeles, Calif., Nov. 13-18, 1962.

Examples of the inaccuracy of numerical integration (Cowell's method) of satellite orbits for many cycles are given. A mathematical model applicable to the perturbation of an orbiting solar observatory by radiation pressure or to testing an electrical propulsion system is used to illustrate one analytical procedure, the Krylov-Bogoliuboff method, which results in a closed form solution to first order. In the 2-dimensional case, the major axis remains constant while the orbit approaches a straight line so that eccentricity tends to 1. In the 3-dimensional case, the major axis again remains unchanged but the eccentricity, inclination and argument of perigee oscillate between limits which are independent of the magnitude of the acceleration due to the radiation pressure. (Contractor's abstract)

3278

Westinghouse Electric Corp. [Air Arm Div.] Baltimore, Md.

VALIDITY OF SERIES EXPANSIONS OF KEPLER'S EQUATION, by E. W. Paul. [1962] [2]p. incl. diagrs. (AFOSR-J1023) (AF 49(638)1002) AD 419880 Unclassified

Also published in AIAA Jour., v. 1: 1659-1660, July 1963.

A solution of the Kepler equation $M = E - e \sin E$ is discussed. In digital computation, very often preference is given to a Taylor expansion progressing in powers of the time. The complex representation of the Kepler equation as an analytical function shows clearly the limited interval of convergence. (Contractor's abstract)

3279

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

AN EFFECT OF OXYGEN ON GRAIN GROWTH IN ZONE-REFINED LEAD, by G. F. Bolling. [1962] [2]p. incl. illus. (AFOSR-1626) (AF 49(638)1029) Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 635-636, June 1962.

Experiments to determine the effect of oxygen on grain growth in zone refined lead were conducted. The results supported the prediction that small concentrations of oxygen would affect investigation on the fundamental properties of pure lead.

3280

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

ERRATUM: ADDENDUM TO SOME THERMAL DATA FOR Bi_2Te_3, by G. F. Bolling. [1962] [2]p. incl. diagr. (AFOSR-1627) (AF 49(638)1029) Unclassified

Also published in Jour. Chem. Phys., v. 36: 1085-1086, Feb. 1962.

The equation previously given by the author (Jour. Chem. Phys., v. 33: 305, 1960) for the specific heat C_p of Bi_2Te_3 is incorrect. In the experiment, samples were transferred from a furnace at temperature T_1 to a calorimeter at T_2 to obtain heat contents. It has been deduced that each measurement of furnace temperature

was too low by 26° to 31 °C; to correct this error, each heat content, $\Delta H = H_{T_1} - H_{T_2}$, was shifted upwards in temperature by about 28.5 °C. The corrected data are presented in graph form.

3281

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

STUDY OF THE GROWTH MECHANISM AND TWIN HABITS OF $Ba_2TiP_2O_9$, by D. E. Harrison and W. A. Tiller. [1962] [7]p. incl. illus. diagrs. table, refs. (AFOSR-2127) (AF 49(638)1029) Unclassified

Also published in Jour. Appl. Phys., v. 33: 2451-2457, Aug. 1962.

Crystals of $Ba_2TiP_2O_9$ were grown from the melt by the Bridgman technique. Two types of twinning occur, namely: growth twins and mechanical twins. The growth twins form with the (100) plane as the twin plane and mechanical twins form with the (001) plane as the twin plane. In twinned crystals, growth proceeds most rapidly in the [010] direction. Rapid growth in this direction is believed to result from efficient nucleation at the re-entrant corners formed by the {310} faces of the twin components. The mechanical twins form according to pseudo-merohedral symmetry by reflection across the (001) twin plane. The angle of obliquity is 4° and the twinning shear is 0.140. (Contractor's abstract)

3282

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

DISCUSSION OF THE J. R. LOW, JR. PAPER ON THE DEFORMATION AND FRACTURE OF IRON, by R. W. Armstrong. [1962] 8p. incl. illus. diagrs. (Scientific paper no. 62-925-116-P2) (AFOSR-2353) (AF 49(638)1029) AD 611199 Unclassified

The purpose of this discussion is to direct further attention to the severe matrix (and twin) plastic accommodation experimentally observed in the vicinity of mechanical twins in bcc metals, e.g., α iron. This plastic accommodation is intimately associated with the twinning shear displacement, the twin size, and the twin shape. The reason for this distortion being prominent in the bcc metals will be illustrated. An appreciation for the nature of this accommodating flow might allow a better understanding of the relationships between slip, twinning, and fracture in α iron. (Contractor's abstract)

3283

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

CONTROLLED FREEZING OF WATER, by J. D. Harrison and W. A. Tiller. Jan. 12, 1962 [20]p. incl. illus. diagrs. refs. (Scientific paper no. 925-11601-P1) (AFOSR-2355) (AF 49(638)1029) AD 276091 Unclassified

Direct observation of the solid-liquid interface during the freezing of aqueous solutions reveals many interesting morphological details related to the different modes of solidification. The development of the cellular interface morphology has been studied in some detail and quantitative estimates of both the degree of segregation to cell boundaries and the volume fraction of this segregate have been made. (Contractor's abstract)

3284

[Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.]

SOME REMARKS ON GRAIN BOUNDARY MIGRATION, by G. F. Bolling. Apr. 10, 1962 [4]p. (AFOSR-2649) (AF 49(638)1029) Unclassified

Studies of grain boundary migration in zone-refined metals have all shown that the rate of migration is greatly reduced by small added solute concentrations. However, it is apparent that a difference exists between boundary migration during normal grain growth and single boundaries migrating in a bicrystal to consume a substructure. To effect the same reduction in velocity in the 2 cases, more solute is required for grain growth than for the single boundary experiments. The rate of grain boundary migration is dependent on solute concentration and must therefore also depend on the solute distribution. In the single boundary experiments, a low-angle substructure, within single crystals obtained by growth from the melt, was used to provide the driving force to move a grain boundary; in grain growth, no substructure of this magnitude was present. Other observations support the hypothesis that a magnified solute concentration impedes the single boundary migration. It is clear, even without a detailed theory, that the apparent activation energies and exact solute dependence must be different as long as the nonuniform solute distribution produced by the substructure is important. Recrystallization experiments should also be susceptible to the same kind of local segregation at subboundaries or dislocation cell walls.

3285

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

DEFORMATION TWINNING IN B.C.C. METALS, by R. W. Armstrong. Mar. 13, 1962 [8]p. incl. diagrs. (Scientific paper no. 62-925-116-P2) (AFOSR-2345) (AF 49(638)1029) AD 280561 Unclassified

Also published in Iron and its Dilute Solid Solutions; Proc. of a Conf., Detroit, Mich. (Oct. 23, 1961), ed. by C. W. Spencer and F. E. Werner. New York, Interscience Publishers, 1963, p. 263-267.

The distortion in body centered cubic (bcc) metals, e.g., α-iron, is shown to be progressively effected by twinning displacement, twin size and shape. A concentration of stress may be necessary to produce a twin nucleus which in some circumstances (i.e., low temperatures) appear to spread catastrophically. Caution should be

used in comparing mechanical twinning in bulk material and thin foils because size effects seem to exist.

3286

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

SOLIDIFICATION, by W. A. Tiller. June 1, 1962 [110]p. incl. illus. diagrs. refs. (AFOSR-3872) (AF 49(638)1029) AD 286423 Unclassified

This report is concerned only with the formation of a solid from its melt where the phase transformation is generally driven by the extraction of heat from the melt. The first portion deals with the fundamentals of the freezing process under the headings: (1) nucleation, (2) interface motion kinetics, (3) solute manipulation, (4) interface morphologies and (5) physical imperfections. The latter portion of the paper deals with the application of these fundamentals to phase diagram studies and ingot solidification.

3287

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

A MATHEMATICAL ANALYSIS OF SOLUTE REDISTRIBUTION DURING EVAPORATION WITH A CARRIER GAS, by W. A. Tiller. July 23, 1962 [12]p. incl. diagrs. (Scientific paper no. 62-944-116-P1) (AFOSR-3886) (AF 49(638)1029) AD 288893 Unclassified

Control of solute flux entering a carrier gas stream required a knowledge of the solute distribution in the liquid during the evaporation and the gas-phase boundary layer characteristics at the surface of the liquid. A mathematical analysis is presented of the solute redistribution in a 1-dimensional liquid system as a function of position and time during evaporation at a constant rate. Evaporation kinetics are assumed to be sufficiently rapid for equilibrium to prevail at the surface of the liquid and the evaporation flux is assumed to be transport controlled. It is further assumed that the flow of carrier gas is sufficient to produce a solute boundary layer of thickness 2L at the surface. The solute concentration outside this boundary layer is that of the in-coming carrier gas. Cases of purely diffusional transport in the liquid (no mixing) and of primarily convective transport in the liquid (partial mixing) are considered.

3288

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

A DEVICE FOR ACCURATE REPOSITIONING OF AN X-RAY DIFFRACTION GONIOMETER, by G. F. Bolling. Oct. 8, 1962 [3]p. incl. diagr. (Scientific paper no. 62-944-116-P3) (AFOSR-4000) (AF 49(638)1029) AD 290685 Unclassified

Also published in Rev. Scient. Instr., v. 34: 706-707, June 1963.

A description is presented of a device which provides an inexpensive and time-saving method for repositioning a goniometer. This device has an accuracy superior to that available on commercial x-ray diffraction equipment. No increase in the absolute angular position is obtained, but the device is quite useful in experiments which require accurate comparative data.

3289

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

MIGRATION OF A LIQUID ZONE THROUGH A SOLID: PART I, by W. A. Tiller. Dec. 18, 1962 [25]p. incl diagrs. tables, refs. (Scientific paper no. 62-944-116-P6) (AFOSR-4645) (Sponsored jointly by Advanced Research Projects Agency; and Air Force Office of Scientific Research under AF 49(638)1029) AD 406472 Unclassified

Also published in Jour. Appl. Phys., v. 34: 2757-2762, Sept. 1963.

The migration of slab, cylindrical and spherical zones through a block of solid under the influence of a temperature gradient has been analyzed theoretically. The migration rate is found to be directly proportional to the temperature gradient in the system and to depend upon orientation – dependent atomic kinetics of the melting and freezing processes. The magnitude of the atomic kinetic effect depends upon the size of the molten zone. Stable zone migration occurs only in certain crystallographic orientations. The theory is discussed in terms of the limited experimental results available.

3290

Westinghouse Electric Corp. Westingouse Research Labs., Pittsburgh, Pa.

MIGRATION OF A LIQUID ZONE THROUGH A SOLID: PART II, by W. A. Tiller. Dec. 18, 1962 [18]p. incl. diagrs. (Scientific paper no. 62-944-116-P7) (AFOSR-4646) (Sponsored jointly by Advanced Research Projects Agency; and Air Force Office of Scientific Research under AF 49(638)1029) AD 432747 Unclassified

Also published in Jour. Appl. Phys., v. 34: 2763-2767, Sept. 1963.

The migration of slab, cylindrical and spherical zones through a block of solid under the influence of an electric field gradient has been analyzed theoretically. It was determined that the zone could migrate either up or down the field gradient, E^*, depending upon the magnitude and sign of (1) the effective ionic mobility of the solvent atoms, U, (2) the Peltier coefficient at the solid-melt interface, and (3) the imposed temperature gradient, G^*.

3291

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

MEASUREMENTS OF STACKING-FAULT PROBABILITIES IN BULK SPECIMENS, by H. M. Otte, D. O. Welch, and G. F. Bolling. Nov. 29, 1962 [7]p. incl. tables. (Scientific paper no. 62-944-116-P4) (AFOSR-4658) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1029 and Office of Naval Research) AD 406475 Unclassified

Also published in Philos. Mag., v. 8: 345-348, Feb. 1963.

The presence of residual elastic strains in deformed bulk specimens can contribute to the shifts of x-ray reflections. This is important in elastically anisotropic face-centered cubic metals and can contribute to calculations of stacking-fault probabilities. An example of such an effect in measurements on zone-refined lead at 4.2° K is examined. (Contractor's abstract)

3292

Westinghouse Research Corp. Westinghouse Research Labs., Pittsburgh, Pa

EFFECT OF GRAIN BOUNDARIES ON SOLUTE PARTITIONING DURING PROGRESSIVE SOLIDIFICATION, by W. A. Tiller. [1962] [2]p. incl. diagr. (AFOSR-J598) (AF 49(638)1029) AD 414373 Unclassified

Also published in Jour. Appl. Phys., v. 33: 3106-3107, Oct. 1962.

It can be shown that significant grain boundary segregation occurs during progressive solidification only when constitutional supercooling is present in the liquid ahead of the freezing interface. An extension of the analysis of cell boundary grooves shows that steep-walled grooves are stable only when a certain degree of constitutional supercooling in the liquid is exceeded. (Contractor's abstract)

3293

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

A SEARCH FOR HOST SENSITIZED LUMINESCENCE OF RARE EARTH IONS IN $Sr_2ZrP_2O_9$, by N. T. Melamed and D. E. Harrison. Dec. 28, 1962 [13]p. incl. diagr. (AFOSR-4647) (AF 49(638)1177) AD 406473 Unclassified

The compound $Sr_2ZrP_2O_9$ belongs to a family of host luminescent materials whose properties appeared to be favorable for the production of host-sensitized luminescence. However, measurements which were performed on this compound activated by rare earths indicated that little or no sensitization was taking place. An estimate of the expected sensitized luminescence yields indicates that the failure to obtain sensitization can be accounted for by the low oscillator strengths of the rare earth ions. It suggests that rare earth ions are in general not well suited as activators in host sensitized systems except at comparatively high concentrations.

3294

Wisconsin U. Dept. of Bacteriology, Madison.

METABOLIC CONTROL OF β-GLUCOSIDASE SYNTHESIS IN YEAST, by A. M. MacQuillan and H. O. Halvorson. [1962] [8]p. incl. diagrs. tables, refs. (AFOSR-4228) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)314, and National Science Foundation) Unclassified

Also published in Jour. Bacteriol., v. 84: 23-30, July 1962.

The hybrid Saccharomyces fragilis x S. dobzhanskii produced a constitutive β-glucosidase when grown in succinate synthetic medium. Upon addition of β-glucosides, thio-β-glucosides, or low concentrations of glucose, a further induction of enzyme synthesis was observed. Studies with other sugars revealed some specificity in response to hexose induction. Phenyl-thio-β-D-glucoside did not affect constitutive synthesis nor induction by glucosides, thio-glucosides, or glucose. Repression of β-glucosidase synthesis is brought about by high concentrations of glucose and other carbon compounds. Preinduction does not confer resistance to catabolic repression of enzyme synthesis; this leads to the conclusion that 2 sites of control for β-glucosidase synthesis are present in yeast. Multiplicity of control is further suggested from: (1) the properties of the inducing system; (2) semiconstitutive nature of enzyme synthesis; (3) the repression of constitutive synthesis by glucose; (4) the elevated derepressed rates of enzyme synthesis after glucose inhibition, and (5) the selection of a family of low constitutive mutants with variable inducibility. (Contractor's abstract)

3295

Wisconsin U. Dept. of Bacteriology, Madison.

PHYSIOLOGICAL CHANGES OCCURRING IN YEAST UNDERGOING GLUCOSE REPRESSION, by A. M. MacQuillan and H. O. Halvorson. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-4229) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)314, and National Science Foundation) Unclassified

Also published in Jour. Bacteriol., v. 84: 31-36, July 1962.

Growth of the hybrid yeast Saccharomyces fragilis x S. dobzhanskii on glucose or lactate resulted in (1) the possible impairment of a permeation system for succinic acid, (2) the repression of succinic and isocitric dehydrogenases and β-glucosidase, and (3) the induction of isocitratase. The latter 2 changes were not observed in S. lactis Y14, in which β-glucosidase synthesis is resistant to glucose repression. (Contractor's abstract)

3296

Wisconsin U. Dept. of Bacteriology, Madison.

ELECTRON TRANSPORT IN SPORE GERMINATION, by H. O. Halvorson. [1962] [1]p. (AFOSR-4231) (AF 49-(638)314) Unclassified

Presented at Sixteenth annual meeting of the Soc. of General Physiologists, Marine Biological Lab., Woods Hole Mass., Sept. 5-7, 1961.

Also published in Jour. Gen. Physiol., v. 45: 601A, Jan. 1962.

The bacterial endospore represents the most extreme case of dormancy known in biology. Bacterial spores differ from their homologous vegetative cells both in chemical composition and in enzyme composition. In particular, spores contain a dormant, soluble flavoprotein system for terminal respiration whereas vegetative cells utilize a particulate, cytochrome-containing system. During activation and germination, spores release calcium dipicolinic acid and activate their electron transport system. Activated spores are germinated in response to L-alanine. The initial site on the spore for bending L-alanine was identified as an L-alanine dehydrogenase. The enzyme has been purified and characterized, and it requires DPN. The soluble DPNH oxidase has been partially purified and its interaction with dipicolinic acid examined. The findings can be understood if dipicolinic acid acts as an electron acceptor. In order to explain the role of dipicolinic acid stimulation of DPNH oxidase a 2-step mechanism was proposed. Assuming that dipicolinic acid can act as an electron acceptor, it provides an explanation for the burst in respiratory activity during sporulation, the rise in respiration following activation and germination of spores, the control of L-alanine-induced germination, and the germination of spores under anerobic conditions. The changes in the electron transport system during sporulation and germination provide a model system for a study of cellular differentiation.

3297

Wisconsin U. [Dept. of Bacteriology] Madison.

THE FUNCTION AND CONTROL OF INTRACELLULAR PROTEIN TURNOVER IN MICROORGANISMS, by H. O. Halvorson. [1962] [9]p. incl. diagrs. tables. refs. (AFOSR-4232) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)314, National Institutes of Health, and National Science Foundation) AD 407568 Unclassified

Also published in Amino Acid Pools, Symposium on Free Amino Acids, Duarte, Calif. (May 1961), New York, Elsevier, 1962, p. 646-654.

Microorganisms contain metabolic pools of nucleotides and amino acids which are on the main line of synthesis of macromolecules. These endogenous metabolic pools are derived either from exogenously provided components or synthesized in vivo from NH_3 and glucose

The recent demonstrations in bacteria, yeast and mammalian cells that under certain conditions nucleic acids and proteins are labile and are degraded to their constituent precursors provides yet another mechanism for internally replenishing these metabolic pools. Under conditions permitting protein and nucleic acid synthesis, a dynamic turnover exists due to the simultaneous breakdown and reutilization of the degradation products for synthesis. Two of the central questions raised by the demonstration of protein and nucleic acid turnover are, What are the control mechanisms governing its function and does this turnover have any significance to the physiology of the cell?

3298

Wisconsin U. Dept. of Bacteriology, Madison.

[COMPLEX PRECURSORS OF INDUCED ENZYMES IN YEAST] by H. O. Halvorson. Annual status rept. Aug. 31, 1961-Sept. 1, 1962. 12p. incl. diagrs. tables. (AF 49(638)314) AD 291145 Unclassified

An active system has been achieved in yeast for amino acid incorporation in cell free systems. The properties of this system are largely analogous to those reported in bacteria and in higher organisms. This system will provide an experimental tool for studying the mechanism of protein synthesis in yeast.

3299

Wisconsin U. Dept. of Bacteriology, Madison.

COMPARISON OF THE α-GLUCOSIDASES OF SACCHAROMYCES PRODUCED IN RESPONSE TO FIVE NON-ALLELIC MALTOSE GENES, by H. O. Halvorson, S. Winderman, and J. Gorman. [1962] [12]p. incl. diagrs. tables, refs. (AFOSR-J645) (AF AFOSR-62-205) AD 413633 Unclassified

Also published in Biochim. et Biophys. Acta, v. 67: 42-53, Jan. 1963.

A comparison has been undertaken of the α-glucosidases produced in Saccharomyces in response to 5 non-allelic maltose genes. The partially purified enzymes were found to be indistinguishable in regard to heat activation, electrophoretic mobility, chromatography from CM-cellulose or DEAE-cellulose columns, neutralization with specific antiserum, or substrate specificity. In each of the genotypes only a single species of α-glucosidase was observed.

3300

Wisconsin U. Dept. of Chemistry, Madison.

HALOGENATION WITH COPPER(II). I. SATURATED KETONES AND PHENOL, by E. M. Kosower, W. J. Cole and others. [1962] [4]p. incl. refs. (AFOSR-64-1401A) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)252 and National Science Foundation) AD 444447 Unclassified

Presented in part at Org. Chem. Div. of the Amer. Chem. Soc., New York, Sept. 11-16, 1960.

Abstract published in 138th National meeting of the Amer. Chem. Soc., Abstracts of Papers, 1960, 7-P.

Also published in Jour. Org. Chem., v. 28: 630-633, Mar. 1963.

A procedure for halogenation of enolizable compounds using copper(II) chloride or bromide in dimethylformamide is described. Methyl ethyl ketone yields 55-70% 3-chlorobutanone, methyl cyclopropyl ketone yields both chloromethyl and dichloromethyl cyclopropyl ketones, propiophenone gives an excellent yield of α-chloropropiophenone, and phenol leads to o- and p-chlorophenols, in a ratio (1:6) substantially different from that of other chlorination methods, along with some 2,4-dichlorophenol. A convenient test for relative reactivities of enols and enolizable compounds is also included. (Contractor's abstract)

3301

Wisconsin U. Dept. of Chemistry, Madison.

HALOGENATION WITH COPPER(II). II. UNSATURATED KETONES, by E. M. Kosower and G.-S. Wu. [1962] [3]p. incl. diagr. tables, refs. (AFOSR-64-1401B) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)282 and National Science Foundation) AD 444447 Unclassified

Presented in part at Org. Chem. Div. of the Amer. Chem. Soc., New York, Sept. 11-16, 1960.

Abstract published in 138th National meeting of the Amer. Chem. Soc., Abstracts of Papers, 1960, 7-P.

Also published in Jour. Org. Chem., v. 28: 633-638, Mar. 1963.

The halogenation procedure described in item no. 3300 was applied to a number of unsaturated ketones. 2-Cyclohexenone and 3-methyl-2-cyclohexenone gave phenol and m-cresol, respectively. Isophorone yielded 3-chloromethyl-5,5-dimethyl-2-cyclohexenone and 6-chloro-3,5,5-trimethyl-2-cyclohexenone in about equal quantities along with a lesser quantity of some phenols. Mesityl oxide and isomesityl oxide form mixtures (in different proportions) of almost every possible monochlorinated product. Methyl vinyl ketone leads to 3-chloro-3-buten-2-one. The mechanisms for the halogenation reactions are discussed. (Contractor's abstract)

3302

Wisconsin U. Dept. of Chemistry, Madison.

ORGANOSILYL AZIDES, by R. West and J. S. Thayer. [1962] [2]p. (AFOSR-2363) (AF 49(638)285) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1763-1764, May 1962.

The first organosilyl azides, R_3SiN_3 (R = Ph, Me) were synthesized by refluxing the corresponding chloride with NaN_3 and anhydrous $AlCl_3$ in tetrahydrofuran. Ph_3SiN_3 (I), m.p. 81°, was a white crystalline solid, insoluble in H_2O, but soluble in most organic solvents. $PhMe_2SiN_3$ (II) was a colorless liquid, b.p. 70°, while Me_3SiN_3 (III), prepared in 90% purity, was a volatile, easily hydrolyzable liquid. I was stable to hydrolysis in water or in aqueous base, but acetone-water mixtures or addition of H^+ led to immediate liberation of azide ion. II and III hydrolyzed readily under all conditions, though more slowly than the corresponding chlorides. I was thermally quite stable, being only 50% decomposed after 10 hr at 220° in hexadecane. All three azides underwent ready photolysis with probable formation of azene intermediates. I and III formed isolable products when heated with Ph_3P. The unexpected stability of I was probably due to strong dative π-bonding between the Si and the N to produce a linear Si-N-N-N configuration, in contrast to the bent structure of organosilyl azides.

3303

Wisconsin U. Dept. of Chemistry, Madison.

THE MONOADDITION OF PHENYLSILANE TO CYCLIC POLYOLEFINS, by R. E. Bailey, L. S. Tutas, and R. West. [1962] [2]p. (AFOSR-64-0218) (AF 49(638)285) AD 432507 Unclassified

Also published in Jour. Org. Chem., v. 28: 1417-1418, May 1963.

The addition of phenylsilane to 1,5,9-cyclododecatriene using benzoyl peroxide and chloroplatinic acid as catalysts failed to give any of the desired tricyclic silicon analog of perhydro-9b-borphenalene (I), as has been previously reported. Chloroplatinic acid catalysis led only to polymeric material, but with benzoyl peroxide a 16% yield of 9-phenylsilyl-1,5-cyclododecadiene (II) was obtained. The monoaddition product is completely unreactive toward further addition, being recovered unchanged after 7 days of heating with benzoyl peroxide catalyst. Similar results were obtained in the addition of phenylsilane to 1,5-cyclo-octadiene, which led only to the monoadduct, 5-phenylsilylcyclooctene. The reluctance of silicon to add to form the perhydrosilaphenalene ring may result in part from the large radius of the silicon atom, which would prevent the molecule from assuming a strainless configuration. However, unsuccessful attempts to cyclize 5-pentenyl-dichlorosilane by intramolecular Si-H addition suggest that the mechanism of silane addition may require a geometry which makes the formation of a six-membered ring unfavorable. With either chloroplatinic acid or benzoyl peroxide, 5-pentenyldichlorosilane gave none of the desired 1,1-dichlorosilacyclohexane, even though the latter compound can assume a strainless chair like configuration.

3304

Wisconsin U. Dept. of Chemistry, Madison.

TIN TETRAHALIDE ADDUCTS OF BICYCLOHEPTADIENE AND THEIR FRAGMENTATION, by F. M. Rabel

and R. West. [1962] [1]p. incl. diagrs. (AF AFOSR-62-244) Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 4169, Nov. 5, 1962.

$SnCl_4$ and $SnBr_4$ have been added to bicycloheptadiene to yield crystalline 1:1 adducts which are formulated as substituted nortricyclenes. The compounds undergo a fragmentation reaction when treated with water or bases to reform bicycloheptadiene and a tin containing fragment.

3305

Wisconsin U. [Dept. of Mathematics] Madison

A CONVEXITY CONDITION IN BANACH SPACES AND THE STRONG LAW OF LARGE NUMBERS, by A. Beck. [1961] [6]p. (In cooperation with Cornell U., Ithaca, N. Y.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)868 and Office of Naval Research) Unclassified

In a recent paper the author showed the theorem: Let χ be a Banach space and $\{X_i\}$, be a sequence of independent random χ-variables with $E(X_i) = 0$ all $i > 0$. Under appropriate conditions on χ and on $\{X_i\}$, we can then assert that $(1/n)\sum_{i=1}^{n} X_i$ converges to 0 in the strong topology of χ almost surely, under the hypotheses that χ is uniformly convex and that the variances of X_i are uniformly bounded ($\mathrm{Var}(X_i)=E(X_i^2)$). Using the same methods to show a necessary and sufficient condition on the Banach space the author obtains this particular strong law of large numbers. A Banach space χ is said to have property (A) if, for every sequence $\{X_i\}$ of independent random χ-variables with $E(X_i)=0$, all i, and $\mathrm{Var}(X_i) < M$, all i, we have $\frac{1}{n}\sum_{i=1}^{n} X_i \to 0$ strongly almost surely.

A Banach space χ is said to have property(B) if there exists an integer $k > 0$ and $\epsilon > 0$ such that any choice $a_1, a_2, \ldots, a_k$ of elements from χ with $a_i \neq 1$ gives us $\pm a_1 \pm a_2 \pm \ldots \pm a_k < k(1 - \epsilon)$ for some combination of the - and - signs.

3306

Wisconsin U. [Dept. of Sociology] Madison.

NOTE ON RELIGIOUS GROUP DIFFERENCES IN INTERACTION PROFILES: A REPLICATION STUDY, by R. Crowther. [1962] [6]p. incl. table. (AFOSR-2981) (In cooperation with Cornell U., Ithaca, N. Y., AF AFOSR-61-30) (AF AFOSR-62-16) Unclassified

Also published in Psychol. Repts., v. 10: 459-464, Apr. 1962.

For abstract see item no. 734, Vol. VI.

3307

Wisconsin U. Dept. of Sociology, Madison.

THE MEANING OF SOME POPULAR VARIABLES, by E. F. Borgatta. [1962] [9]p. incl. tables, refs. (AFOSR-2387) (AF AFOSR-62-16) AD 450006 Unclassified

Also published in Jour. Social Psychol., v. 63: 309-317, 1964.

The structure of variables based on how persons assess each other is described. Within this structure, consideration is given to some popular concepts that occur in the research literature. Attention is given to the fact that if an attribute of a person is described as a tendency to behave in a given way, some direct basis of assessment is implied. Paper-and-pencil tests measure the tendency to respond to the test in a given way. It is an unwarranted inferential jump to assume such tests are measures of tendencies to behave in given ways in interpersonal relations. Exploration of paper-and-pencil tests with direct measures of interpersonal behavior should occur with knowledge of the systematic structure of the latter. (Contractor's abstract)

3308

Wisconsin U. [Dept. of Sociology] Madison.

SOME TASK FACTORS IN SOCIAL INTERACTION, by E. F. Borgatta. [1962] [13]p. incl. tables. (AFOSR-2485) (In cooperation with New York U., N. Y.) (AF 49(638)195 and AF AFOSR-62-16) Unclassified

Also published in Sociol. and Social Research, v. 48, Oct. 1963. (AFOSR-64-0014)

The amount of social responsibility that is placed on the individual for what he says and does, particularly with regard to his negative emotional responses, is seen as an important dimension in the study of interpersonal behavior. An observation situation is constructed in which subjects participate in a no-load condition, and this is compared to other discussion and role playing. Interpretable differences in profiles occur. In addition, anticipated and unanticipated differences are found according to the experimental manipulation within the no-load observation situation. (Contractor's abstract)

3309

Wisconsin U. Dept. of Sociology, Madison.

PROBLEMS OF OPERATIONAL DEFINITIONS OF "EMPATHY", "IDENTIFICATION" AND RELATED CONCEPTS, by G. Marwell. [1962] [16]p. incl. tables, refs. (AFOSR-2713) [AF AFOSR-62-16] AD 450024 Unclassified

Also published in Jour. Social Psychol., v. 63: 87-102, 1964.

This paper contains two main sections. The first, included mainly for pedagogical purposes, reviews the commonly noted operational traps into which researchers working with measures of social perception may fall. The second major section deals with what might be called errors of omission. Through a systematic analysis of the operations involved in several measures of social perception currently in use, it points to the vast number of implied measures as yet unrecognized, unexplained and unexplored.

3310

Wisconsin U. [Dept. of Sociology] Madison.

SOME TASK FACTORS IN SOCIAL INTERACTION, by E. F. Borgatta. [1962] [8]p. incl. tables. (AFOSR-64-0014) (In cooperation with New York U., N. Y.) (AF 49(638)195 and AF AFOSR-62-16) AD 434522
Unclassified

Also published in Sociol. and Social Research, v. 48, Oct. 1963.

For abstract see item no. 3308, Vol. VI.

3311

Yale U. [Dept. of Astronomy] New Haven, Conn.

ON THE EXISTENCE OF A THIRD INTEGRAL OF MOTION, by G. Contopoulos. [1962] [14]p. incl. diagrs. refs. (AFOSR-J427) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-380 and Office of Naval Research) AD 407246 Unclassified

Also published in Astronom. Jour., v. 68: 1-14, Feb. 1963.

The aim of this paper is to unify the work done until now from different points of view on a third integral of motion besides the energy and the angular momentum integrals, and to present a number of applications and generalizations. In the Introduction, different methods for finding integrals of motion are discussed. The third integral is explicitly calculated by means of von Zeipel's method. In the next section different definitions of integrable systems are given and a distinction between useful and nonuseful integrals is made. Poincare's nonexistence theorem is mentioned and its many exceptions are pointed out. Then a distinction of separable and nonseparable systems is made. It is seen that by introducing contact transformations many dynamical systems become separable. This explains the fact that in the case of 2 degrees of freedom the orbits are in general distorted Lissajous figures. The problem of the convergence of the third integral is the subject of the next section. Siegel gave a proof that in general the formal third integral does not converge. However, one can approximate any Hamiltonian, that is given as a polynomial or a series, by another Hamiltonian that possess converging integrals, coinciding with the given Hamiltonian up to the terms of any degree. Numerical results provide ample evidence that the third integral exists in quite general potential fields, as in Schmidt's model of the Galaxy, in slightly elliptical clusters or galaxies, in the field of the oblate earth, in resonance cases where the unperturbed frequences have a rational ratio, and in potential fields that do not have a plane of symmetry. In the case of non-axially symmetric systems two new integrals are introduced. However, no integral corresponds to the angular momentum. In an asymmetric galaxy initially circular orbits after some time pass near the center of the galaxy. The third integral can be applied to the boundaries of the orbits and their hodographs, to the study of periodic orbits, to the dispersion of a group of stars, to the three-axial velocity ellipsoid, to the construction of models of the Galaxy, etc. Finally a practical method for searching for new integrals is indicated.

3312

Yale U. [Dept. of Mathematics] New Haven, Conn.

REMARKS ON DIFFERENTIAL EQUATIONS IN BANACH ALGEBRAS, by E. Hille. [1962] [6]p. (AFOSR 64-0210) (AF 49(638)224) AD 432570 Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, ed. by G. Szegö, C. Loewner, and others, Stanford, Calif., Stanford U. Press, 1952, p. 140-145.

Some examples are given illustrating the behavior of solutions of analytic ordinary differential equations with isolated singularities in a non-commutative Banach algebra. Various results are given concerning the behavior of solutions of differential equations whose coefficients are quasi-nilpotent elements of the algebra. (Math. Rev. abstract)

3313

Yale U. [Dept. of Mathematics] New Haven, Conn.

A CONVEX CLASS OF POLYNOMIALS AND AN ASSOCIATED LOCUS PROBLEM, by L. Brickman. [1962] [6]p. (AF 49(638)224) Unclassified

Published in Jour. Math. Anal. and Appl., v. 4: 207-211, 1962.

The author shows how his previous results on the range of values P(z) for fixed complex z, which were obtained by means of Radau quadrature formulas, can be obtained by methods similar to those used by I. J. Schoenberg and G. Szegö for real z. This is not done by any trivial extension of the techniques of the Schoenberg-Szegö paper, but requires an interesting characterization of the boundary of an ellipse.

3314

Yale U. Dept. of Mathematics, New Haven, Conn.

A LOCALLY CONVEX ALGEBRA OF ANALYTIC FUNCTIONS, by L. Brickman. [1962] [7]p. (AF 49(638)224) Unclassified

Published in Jour. Math. and Mech., v 11: 473-479, May 1962.

Let $D_R = \{ z \mid |z| < R \}$, $0 < R \leq 1$, and let A_R be the set of functions f holomorphic in D_R such that $f(0) = 0$. This set is given the topology of uniform convergence on compact subsets of D_R. In order to treat multiplication and inversion problems of Möbius, a commutative, associative multiplication in A_R is set forth by

$$\{f g\}(z) = \sum_{p=1}^{\infty} z^p \sum_{m n = p} a_m b_n = \sum_{n=1}^{\infty} a_m g(z^m) = \sum_{n=1}^{\infty} b_n f(z^n),$$

where $f(z) = \sum_{m=1}^{\infty} a_m z^m$, $g(z) = \sum_{n=1}^{\infty} b_n z^n$, $f, g \in A_R$. With this definition of multiplication A_R becomes a locally multiplicative convex topological algebra with identity e defined by $e(z) = z$.

If f is defined as above, then f is a regular (invertible) element of the algebra if and only if $a_1 \neq 0$. This gives a simple proof of a theorem. If f, $g \in A_R$ and $g'(0) \neq 0$ then there is a unique sequence $\{c_n\}$ such that $f(z) = \sum_{n=1}^{\infty} a_n g(z^n)$, $|z| < R$. The exponential function exp f maps A_R onto the multiplicative group of invertible elements. If exp f = exp g, then f - g = 2 n π i, i.e. for some integer n and vice versa. (Math. Rev. abstract)

3315

Yale U. [Dept. of Mathematics] New Haven, Conn.

ON NONNEGATIVE POLYNOMIALS, by L. Brickman and L. Steinberg. [1962] [4]p. (AF 49(638)224) Unclassified

Published in Amer. Math. Monthly, v. 69: 218-221, Mar. 1962.

The question of polynomials nonnegative in an interval, finite or half infinite, is discussed. All polynomials mentioned are understood to have real coefficients. A previous result is given as follows: (1) Let the polynomial f(x) be nonnegative for nonnegative x. Then there exist polynomials p(x), q(x), s(x) such that $f(x) = p^2(x) + q^2(x) + [r^2(x) + s^2(x)]x$. In the present note (1) is improved upon to obtain: (2) Let the polynomial f(x) be nonnegative for nonnegative x. Then there exist polynomials p(x) and q(x) such that $f(x) = p^2(x) + q^2(x)x$. (3) Let the polynomial f(x) be nonnegative in the finite interval [a, b]. Then f(x) can be written $f(x) = p^2(x)(x - a) + q^2(x)(b - x)$ if the degree of f(x) is odd, and $f(x) = p^2(x) + q^2(x)(x - a)(b - x)$ if the degree of f(x) is even. p(x) and q(x) can be chosen so that the degree of each term does not exceed the degree of f(x). Proof is given of (2) and (3).

3316

Yale U. [Dept. of Mathematics] New Haven, Conn.

A COORDINATIZATION THEOREM FOR JORDAN ALGEBRAS. by N. Jacobson. [1962] [7]p. (AFOSR-J620) (AF AFOSR 61-29) AD 415106 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 1154-1160, July 1962.

If A is an associative algebra and contains n^2 elements e_{ij}, i, j=1, ..., n, satisfying the usual identities for matrix units. then it is easily proved that A is isomorphic to the algebra B_n of all n x n matrices over an associative algebra B. This paper gives a proof of the analogous (much harder) theorem for Jordan algebras, namely, a characterization of those Jordan algebras which are isomorphic to the Jordan algebra $H(D_n\gamma)$ of n x n matrices over the alternative involutorial algebra D which are hermitian relative to the involution $x \to \gamma^{-1}\bar{x}'\gamma$ in D_n, where $\gamma = \mathrm{diag}(\gamma_1, \ldots, \gamma_n)$, with γ_i self-adjoint invertible elements in the nucleus of D. It is assumed that $n \geq 3$. The case that γ is the identity matrix was handled by the author. The present proof is much simpler and relies on 2 concepts which are of independent interest: regularity (or invertibility) of an element in a Jordan algebra, and isotopic multiplication (an analogue for Jordan algebras to change of multiplication in an associative algebra from xy to xcy, where c is some fixed element of the algebra). (Math. Rev. Abstract)

3317

Yale U. [Dept. of Mathematics] New Haven, Conn.

MACDONALD'S THEOREM ON JORDAN ALGEBRAS, by N. Jacobson. [1962] [10]p. (AFOSR-J621) (AF AFOSR-61-29) AD 415470 Unclassified

Also published in Arch. Math., v. 13: 241-250, 1962.

MacDonald's theorem states that any identity for special Jordan algebras which does not involve more than 3 variables and is linear in one of them, holds for all Jordan algebras. In this paper a new proof of this result is given which is less technical than the original one. Let $J^{(r)}$ and $J_o^{(r)}$ be the free Jordan algebra and the free special Jordan algebra in r generators (over a ground-field which remains fixed). There is a canonical homomorphism $\upsilon: J^{(r)} \to J_o^{(r)}$, mapping genrators onto generators. $J^{(2)}$ and $J_o^{(2)}$ may be identified with subalgebras $J^{(3)}$ and $J_o^{(3)}$, respectively. Let $E[E_o]$ be the associative algebra of linear transformations of $J^{(3)}[J_o^{(3)}]$ generated by multiplications with elements of $J^{(2)}[J_o^{(2)}]$. υ induces a homomorphism of E onto E_o and MacDonald's theorem is equivalent to the assertion that this is an isomorphism. This is the form in which the author proves the theorem. He introduces a free associative algebra F with a countable number of generators and defines an epimorphism $\sigma: F \to E$, which, combined with υ, gives an epimorphism: $\sigma: E \to E_o$. He then proves that the kernels of σ and σ_o coincide with an explicitly given ideal R in F. This is, of course, the crux of the proof. The main steps are: (a) straightening the elements of F modulo R and (b) counting the elements of F/R in a suitable manner. (Math. Rev. abstract)

3318

Yale U. [Dept. of Mathematics] New Haven, Conn.

[A NOTE ON THE MULTIPLICATIVE GROUP OF SOLIDS] Eine Bemerkung über die multiplikative Gruppe eines Körpers, by P. M. Cohn. [1962] [5]p. [AF AFOSR-61-29] Unclassified

Published in Arch. Math., v. 13: 344-348, 1962.

In this paper, the author proves that if the torsion subgroup of an Abelian group G is embedded into the multiplicative group F^X of a field F, then there exists a field extension E of F such that G is a subgroup of E^X and moreover, E^X/F^X is torsion-free. He then derives as a weaker solution to a problem of L. Fuch; an Abelian group G can be embedded into the multiplicative group of a field if and only if the torsion subgroup of G is locally cyclic. In another corollary, the author proves that there exists a field where the multiplicative group does not split relative to its torsion subgroup. (Math. Rev. abstract)

3319

Yale U. [Dept. of Mathematics] New Haven, Conn.

RINGS WITH A WEAK ALGOTITHM, by P. M. Cohn. [1962] [25]p. incl. refs. [AF AFOSR-61-29] Unclassified

Published in Trans. Amer. Math. Soc., v. 109: 332-356, Nov. 1963.

Generalizing the Euclidean algorithm, a weak algorithm is defined for rings. It is shown that a ring satisfying the weak algorithm is a weak Bézout ring, i.e., an integral domain in which any 2 principal right ideals with a non-zero intersection have a sum and intersection which are again principal. Such a ring is necessarily a unique factorization domain. It is demonstrated that free associative algebras (over a field) satisfy the weak algorithm, and more generally that the free product of (any number of) skew fields over a given skew field satisfies a form of the weak algorithm and is a weak Bézout ring. (Math. Rev. abstract, modified)

3320

Yale U. [Dept. of Physics] New Haven, Conn.

THEORY OF PRESSURE SHIFTS OF HCl LINES CAUSED BY NOBLE GASES, by H. Margenau and H. C. Jacobson. [1962] [23]p. incl. diagrs. tables, refs. (AFOSR-64-0260) (AF 18(603)15) AD 432523 Unclassified

Presented in part at Conf. Molecular Line Shapes, Rehovoth, Israel, Aug. 1961.

Also published in Jour. Quant. Spectrosc. Radiat. Transfer v. 3: 35-58, Jan-Mar. 1963.

Recent experimental work has shown that the shift of lines in the 1-0 and 2-0 bands of HCl, when absorbed under perturbation by rare gases, is strongly dependent on the rotational quantum number. To explain this effect, the forces between a rotating and vibrating dipole and a spherically symmetric atom were calculated retaining the influence of space quantization. It is also indicated why space quantization of the dipole with respect to the interaction line matters in this problem. Asymptotic dispersion forces do not account for the results observed, nor should this be expected. But when repulsive forces are included, many experimental features, especially the J-dependence of the shifts, receive at once a qualitative explanation. In part V, 2 models, one very crude and the other more realistic, are employed in an attempt to account for the numerical shifts. The work necessarily involves the use of unknown kinetic theory parameters. Fitting the data leads to their determination; not incontrovertibly to be sure, but in a manner that leaves little doubt as to the basic adequacy of the explanation offered.

3321

Yale U. [Dept. of Physics] New Haven, Conn.

PRESSURE-INDUCED SHIFTS OF HCl LINES (Abstract), by H. C. Jacobson. [1962] [1]p. [AF 18(603)15] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 271, Apr. 23, 1962.

The following abstract (Pressure Shifts of Molecular Lines) suggests in qualitative terms an explanation of the J-dependent frequency shifts observed in the HCl rotation-vibration spectrum perturbed by rare gases. Extensive observations by Jaffe et al. and by Rank et al. offer opportunities for applying various intermolecular-force models to illuminate the problem of the shifts. Therefore, the author calculated the mean-frequency shift with the use of the statistical theory of pressure broadening in terms of Lennard-Jones potentials, allowing the parameters in this potential to reflect the influence of space quantization. Guided by knowledge of the kinetic-theory radii involved, it is shown that a simple choice of these parameters reproduces the general tendencies of the experimental data, although numerical discrepancies with respect to P-branch lines remain.

3322

Yale U. [Dept. of Physics] New Haven, Conn.

PRESSURE SHIFTS OF MOLECULAR LINES (Abstract), by H. Margenau. [1962] [1]p. [AF 18(603)15] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 271, Apr. 23, 1962.

The shifts of HCl lines perturbed by rare gases, as measured by Jaffe et al. and by Rank et al., show a strong dependence on the rotational quantum number J. This cannot be explained as the result of long-range Van der Waals forces. It is shown that the effects encountered are, in part at least, measures of the dependence of short-range interactions upon the magnetic-quantum number M. Discussion includes an appraisal of methods for calculating shifts, a determination of impact radii at which adiabaticity for individual M states exists and a qualitative picture of interaction curves which lead to the experimental findings. The curves incorporate the fact that radiator and perturber have smallest distances of approach when M = J. This prevents the perturbation from vanishing when an average over M is performed and results in J-dependent shifts.

3323

Yale U. [Dept. of Physics] New Haven, Conn.

WIDTHS OF PRESSURE-BROADENED HCl VIBRATION-ROTATION LINES (Abstract), by R. M. Herman. [1962] [1]p. [AF 18(603)15] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 271, Apr. 23, 1962.

Observations of the HCl vibration-rotation lines broadened by foreign gases reveal that the widths, as well as the shifts, show marked variations with J. It is clear that the Anderson theory of line broadening yields theoretical widths which are much smaller than those observed. An alternate theory has been developed in which one uses the "adiabatic representation" to carry out the calculation of line-shape parameters starting from the quantum-mechanical Fourier-integral formula. The advantage of working in this representation is that the deformations of the electronic-state functions are treated accurately. Such accuracy is necessary if one is to account correctly for the effects of dispersion forces in line broadening. A strong dependence of the intermolecular force on the orientation of the HCl molecular axis arises because the center of charge of the polarizable electrons in HCl does not coincide with the center of rotation. This angular dependence is very important and results in large, J-dependent widths. Substantial agreement between predicted and observed linewidths has been obtained for certain foreign gases.

3324

Yale U. [Dept. of Physics] New Haven, Conn.

DENSITY MEASUREMENTS IN SOLID HE^4, by J. N. Kidder. [10]p. incl. diagr. table. (AFOSR-2864) (AF 49(638)690) AD 612 79 Unclassified

Also published in Proc. Eighth Internat'l. Conf. Low Temperature Phys., London (Gt. Brit.) (Sept. 16-22, 1962), Washington, D. C., Butterworths, 1963, p. 419-420.

The measurements were made on solid He^4 in the region of the γ(body-centered cubic) phase discovered by Vignos and Fairbank. Points were taken at constant temperature for 6 temperatures between 1.45°K and 1.73°K. The results for pressures near the melting and transition curves are shown. The lower density γ phase is clearly seen as the first step in the curve. The measured volume changes for melting and for the solid transition are listed. The volume changes for melting agree with those of Grilly and Mills to within 2-3%, while the solid transition volume changes are slightly higher than theirs but in agreement within the experimental error. Their data indicated a minimum in the solid transition volume change near the center of the gamma phase. No such effect is seen here.

3325

Yale U. [Dept. of Physics] New Haven, Conn.

[ELECTRON NUCLEAR INTERACTIONS AND RELATED PROBLEMS], by G. Breit. Final rept. June 1, 1961 - May 31, 1962. [1]p. (AFOSR-2753) (AF AFOSR-61-23) Unclassified

A list of the published work done under grant AF AFOSR-61-23 is presented.

3326

Yale U [Dept. of Physics] New Haven, Conn.

SCATTERING APPROXIMATION FOR LONG RANGE FORCES, by K. R. Greider. [1962] [5]p. incl. diagrs. (AFOSR-J142) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-42 and Atomic Energy Commission) AD 400380 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 392-396, Nov. 1, 1962.

Describes a method of approximating many-body processes in terms of 2-body scattering amplitudes. This method requires at least 1 of the interactions to have long range, and appears to have wide applicability. The reactions $N^{14} + N^{14} \rightarrow N^{13} + N^{15}$ and $p + C^{12} \rightarrow d + C^{11}$ are considered for illustration.

3327

Yale U. [Dept. of Physics] New Haven, Conn.

CRITICAL VELOCITIES AND BOUNDARY INTERACTIONS IN THE ISOTHERMAL FLOW OF SUPERFLUID HELIUM, by J. N. Kidder and W. M. Fairbanks. [1962] [36]p. incl. diagrs. table, refs. (AFOSR-2865) (In cooperation with Duke U., Durham, N. C.) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-87, and Army Research Office (Durham)) AD 612440
Unclassified

Also published in Phys. Rev., v. 127: 987-994, Aug. 15, 1962.

The pressure gradient as a function of the superfluid velocity in a 1.1-mm-diam capillary was measured at 4 temperatures between 1.23 and 1.57 K. In the flow tube the normal fluid was held at rest by ultrafine porosity filters, while the superfluid flowed isothermally. Superconducting microwave cavities were used as level indicators, making it possible to detect pressure gradients as small as 0.0003 dyn/cc. A critical superfluid velocity, below which no pressure gradient could be detected, was observed directly. The critical velocity decreased linearly with temperature, being 1.25 mm/sec at 1.26K, and 0.85 mm/sec at 1.57K. For a superfluid velocity greater than the critical velocity, the variation of the pressure gradient with velocity was described. It is believed that this represents an interaction between vorticity in the superfluid and the wall of the flow tube. (Contractor's abstract, modified)

3328

Yale U. [Dept. of Physics] New Haven, Conn.

[DENSITY MEASUREMENTS AND SOLID HE^3] by J. N. Kidder. Final rept. Dec. 14, 1962. 15p. incl. diagrs. refs. (AFOSR-4749) (AF AFOSR-62-87) AD 408479
Unclassified

This report describes the density measurements as a function of temperature and pressure (PVT relation) made on solid He^4. The isothermal compressibility and the volume changes at the phase transitions have been accurately measured in the region of the body-centered-cubic solid phase. An estimate is made of the isobaric thermal expansion coefficient. The data suggest that thermodynamic relations predicting a negative thermal expansion coefficient in the solid might be altered by the fact that the compressibility of the solid at the melting curve is greater than at higher pressures. Calculations were made on the data of several experiments studying the flow of superfluid helium. There is ample evidence that a dissipative interaction can exist between the superfluid and the boundaries of the flow system when the superfluid velocity is greater than a certain critical value.

3329

Yale U. Dept. of Physics, New Haven, Conn.

GASEOUS OPTICAL MASERS, by W. R. Bennett, Jr. [1962] [38]p. incl. illus. diagrs. tables, refs. (AFOSR-J296) (AF AFOSR-62-463) AD 412347
Unclassified

Also published in Appl. Opt. Suppl. on Opt. Masers, v. 1: 24-62; 105-106, 1962.

A detailed review of the present knowledge of gaseous optical masers is given. The paper is divided into 4 main sections: The first section contains a summary of basic general considerations, ranging from properties of the normal cavity modes through methods of measurement and interpretation in gas systems. The second contains a review of the dominant excitation mechanisms which have been used to produce population inversions in gas lasers. The third and main section considers various aspects of the numerous gas systems in which continuous oscillation has been introduced, and an attempt has also been made to include a number of small engineering details which should be of help in the construction and operation of gaseous optical masers (Contractor's abstract)

3330

Yale U. Sloane Physics Lab., New Haven, Conn.

SYMMETRY PROPERTIES OF WAVE FUNCTIONS IN MAGNETIC CRYSTALS, by J. O. Dimmock and R. G. Wheeler, Jan. 11, 1962. [64]p. incl. diagrs. tables, refs. (AFOSR-2056) (AF 49(638)503) AD 271644
Unclassified

Also published in Phys. Rev., v. 127: 391-404, July 15, 1962.

The symmetry properties of wave functions in magnetic crystals are discussed in terms of the irreducible representations of magnetic space groups. The specific effects of the magnetic ordering on the crystal eigenstates are of 3 types: (1) There is a lifting of some eigenfunction degeneracies because the crystal symmetry is reduced in the magnetic state; (2) New Brillouin zone surfaces are introduced if there is a reduction in translational symmetry; (3) The symmetry of the energy band in K-space may be reduced. The rutile structure is considered as a specific example and the space groups of MnF_2 and MnO_2 in their magnetic and nonmagnetic states are obtained. (Contractor's abstract)

3331

Yale U. [Sloane Physics Lab.] New Haven, Conn.

OPTICAL ABSORPTION EDGE OF INSULATING CRYSTALS AT LOW TEMPERATURES, by R. G. Wheeler. Final rept. Mar. 1, 1959-Aug. 31, 1962,

Aug. 31 1962. 5p. (AFOSR 3536) (AF 49(638)503)
AD 285426 Unclassified

The exciton spectra and their magneto optical effects was investigated in selected insulators, most successfully, cadmium sulfide and cadmium selenide. Theoretical work was carried out on the representation theory of finite groups, in particular, the consideration of the group properties of magnetic crystals. Magneto optical studies of the exciton absorption in other selected semiconductors such as ZnS, HgS and MgTe will be continued. MgTe holds special promise. Due to the hexagonal symmetry and the very large spin orbit splitting of the Te ion it is hoped that one may be able to detect in the exciton evidence for toroidal energy surfaces in band structure. Crystal growth facilities have been constructed which will aid in procurement of suitable samples. A superconducting high field magnet should allow an extension of the field parameter to nearly 60 kilogauss.

3332

Yale U. [Sloane Physics Lab.] New Haven, Conn.

IONIC CONDUCTIVITY AND TIME-DEPENDENT POLARIZATION IN NaCl CRYSTALS, by P. H. Sutter and A. S. Nowick. [1962] [13]p. incl. illus. diagrs. refs. [AF 49(638)503] Unclassified

Published in Jour. Appl. Phys., v. 34: 734-746, Apr. 1963.

When a constant electric field is applied to a dielectric, the current density per unit field decreases with time from an "initial conductivity" to a "final (or steady-state) conductivity." A study is made of this time-dependent polarization effect for "pure" NaCl crystals in the range from 50° to 200°C. The validity of Ohm's law and the superposition principle is demonstrated for these crystals; this establishes the linearity of the formal equation which relates polarization, electric field, and their time derivatives. Also studied are the effect of prolonged current flow, the effect of deliberate introduction of an air gap between the crystal and one of its electrodes, and the effects of impurities, deformation, x-ray irradiation, and annealing. It is concluded that the results are not consistent with the well-known space-charge polarization theory of Joffe, according to which the buildup of space charge occurs because of blocking of the current carriers at one or both electrodes. Rather, it is necessary to regard the time-dependent polarization as a dielectric relaxation phenomenon. According to this viewpoint, the final conductivity, and not the initial value, represents the true ionic conductivity. Possible relaxation mechanisms are discussed in terms of defect clusters and charged jogs on dislocations. (Contractor's abstract)

3333

Yale U. [Sloane Physics Lab.] New Haven, Conn.

HYPERFINE STRUCTURE OF MUONIUM, by K. Ziock, V. W. Hughes and others. [1962] [3]p. incl. diagr. table. (AFOSR-2791) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)545, Atomic Energy Commission and Office of Naval Research) AD 612522 Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 103-105, Feb. 1, 1962.

The h. f. s. splitting of muonium in its ground $1^2S_{1/2}$ state is experimentally found to be 4461. 3 ± 2. 2 mc/sec.

3334

Yale U. Sloane Physics Lab., New Haven, Conn.

THEORETICAL VALUES FOR MAGNETIC MOMENTS OF Mu-MESONIC ATOMS, by K. W. Ford, V. W. Hughes, and J. G. Wills. [1962] [8]p. incl. tables, refs. (AFOSR-3252) (AF 49(638)545) AD 400863 Unclassified

Also published in Phys. Rev., v. 129: 194-201, Jan. 1, 1963.

The magnetic moment of a negative muon bound in the field of a nucleus is slightly less than the moment of a free muon. The binding corrections to the moment have been calculated accurately for a number of nuclei, using realistic nuclear charge distributions. Polarization of the nucleus and of the atomic electrons by the muon also give rise to significant corrections to the muon moment. Precise determinations of the magnetic moment of heavy mu-mesonic atoms afford a way to test for possible structure of the muon which might be exhibited through the polarization of the muon in the strong electric field of the nucleus. The theoretical and experimental g values are in reasonable good agreement in view of the uncertainties about chemical and solid state magnetic shielding effects.

3335

Yale U. [Sloane Physics Lab.] New Haven, Conn.

COLLISIONS OF MUONIUM IN GASES; MUONIUM CHEMISTRY (Abstract), by J. Bailey, W. Cleland and others. [1962] [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., Washington, D. C., Apr 23-26, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 234, Apr. 23, 1962.

Earlier indications of the importance of collisions of muonium in gases to the study of muonium have been confirmed unambiguously in the author's recent measurement of the hyperfine structure of muonium. A microwave-induced transition between 2 hyperfine levels in a strong magnetic field is observed when positive muons are stopped in pure argon; the line intensity is reduced to half when an admixture of about 4 parts in 10^5 of air is added; the line appears with 2 parts in 10^4 of air. Since the probability that a muon forms muonium is not believed to depend on the presence of impurities, the decrease in the muonium-resonance signal is attributed either to chemical reactions of muonium or to changes in muonium polarization in collisions. It is difficult to decide the relative importance of these 2 possibilities, since very little is known about the cross sections for the corresponding processes for hydrogen. It may be possible to observe the microwave spectrum of a molecule such as OM (analog of OH) if it is formed under our conditions. The pressure shift of the hfs of muonium in high-pressure argon gas is discussed.

3336

Yale U. [Sloane Physics Lab.] New Haven, Conn.

SUSCEPTIBILITY OF A LOCALIZED MAGNETIC STATE IN A METAL (Abstract), by J. A. White. [1962] [1]p. [AF 49(638)545] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 23-24, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 557, Nov. 23, 1962.

The susceptibility of an orbitally nondegenerate spin 1/2 atomic impurity state in a metal is calculated on Anderson's model. The totality of many electron atom-metal eigenstates is divided into 2 classes according as the projection of the local moment along the direction of the applied field is positive or negative. The partition function is calculated by summing separately over the 2 classes, within each of which the major contribution comes from states for which the projection has approximately the most probable value $\langle \mu_{\pm} \rangle = \pm \langle \mu \rangle$ for that class. The resulting susceptibility when expressed in terms of $\langle \mu \rangle$ is the sum of a Curielike term and a local contribution to the Pauli spin paramagnetism: $\chi_{loc} = \langle \mu \rangle^2 / kT + \partial \langle \mu \rangle / \partial H$. The magnitude of $\langle \mu \rangle$ depends on the admixture of free-atom and pure-metal states, the density of free-electron states at the Fermi level, the repulsion between localized electrons of opposite spin, and temperature; it is always smaller than for an isolated atom and normally decreases gradually with rising temperature.

3337

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE KINETICS OF THE THERMAL ISOMERIZATION OF [2.1.0] BICYCLOPENTANE, by M. L. Halberstadt and J. P. Chesick. [1962] [4]p. incl. diagrs. tables, refs. (AFOSR-2156) (AF 49(638)722) AD611452 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 2688-2691, July 20, 1962.

The thermal isomerization of [2.1.0] bicyclopentane is a homogeneous unimolecular reaction and has been studied in the range 287.9 to 310.1° and pressures of 66.7 to 0.04 mm. The high-pressure rate constant at 291.2° can be expressed in the Arrhenius form $k_\infty = 10^{14.58} \exp[-(46.6 \pm 1.0)\text{kcal}/RT]\ \text{sec}^{-1}$. The number of effective oscillators in the Kassel integral is estimated as 18 ± 2. Added nitrogen increases the rate in the lower pressure region with a pressure efficiency relative to the reactant molecule of 0.10 ± 0.02. Energy considerations appear to preclude a cyclic strainfree diradical as a transition state. (Contractor's abstract)

3338

Yale U. [Sterling Chemistry Lab.] New Haven, Conn.

KINETICS UNIMOLECULAR AND HALOGEN ATOM REACTIONS, by J. P. Chesick. Final rept. Sept. 6, 1962. 2p. (AFOSR-3485) (AF 49(638)722) Unclassified

This report contains a bibliography of completed studies of various unimolecular reactions in which the activation energy barrier was of interest in consideration of the detailed molecular decomposition processes. For molecules of sufficiently small size, the low pressure behavior of the unimolecular reaction rate constant has yielded information on the relative lifetimes of the energized molecules as a function of molecular size and structure. Incompleted work included: (1) preliminary experiments with methylenecyclopropane which indicated that this molecule did not undergo a simple unimolecular reaction; (2) work on the thermal decomposition of ethylcyclopropane indicating a longer lifetime for the excited species in this unimolecular reaction than was found for methylcyclopropane; and (3) the thermal isomerization of dimethylbicyclobutane which gave tentative Arrhenius parameters of $8.2 \times 10^{13}\ \text{sec}^{-1}$ and 40.4 kcal/mol.

3339

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE KINETICS OF THE THERMAL CIS-TRANS ISOMERIZATION OF 2-METHYL [2.1.0] BICYCLOPENTANE, by J. P. Chesick. [1962] [4]p. incl. diagrs. refs. (Contribution no. 1688) (AFOSR-3890) (AF 49(638)722) AD 611449 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 3250-3253, Sept. 5, 1962.

The kinetics of the reversible cis-trans isomerization reaction of 2-methyl [2.1.0] bicyclopentane were studied between 203.3 and 231.7°C and at reactant pressures between 0.08 and 1.7 mm. If the lower boiling isomer is tentatively identified as trans, then K = k-trans/cis = 0.58 at 220° for the trans-cis reaction. The transition state is concluded to be one of incomplete rupture of the bridgehead-bridgehead bond corresponding to considerable residual bicyclic strain energy. The first order rate constants decreased less than 10% on lowering the reactant pressure to 0.1 mm. (Contractor's abstract modified)

3340

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE THERMAL ISOMERIZATION OF TROPILIDENE, by F. N. Klump and J. P. Chesick. [1962] [3]p. incl. diagr. refs. (AF 49(638)722) Unclassified

Published in Jour. Amer. Chem. Soc., v. 85: 130-132, Jan. 20, 1963.

The thermal isomerization of tropilidene to toluene has been observed in the gas phase in the temperature range 363-408°, and in the pressure range 0.9-19.7 mm. The first-order rate constant was found to be independent of the surface to volume ratio, and unchanged both by nitric oxide addition and by a 20-fold increase in pressure through nitrogen addition.

The rate constant for the reaction is given by $k = 3.5 \times 10^{13} \exp[(-51.1 \pm 0.8)\ \text{kcal/RT}]\ \text{sec}^{-1}$. The activation energy precludes a simple carbon-carbon bond rupture as the initial step, and a species at least formally similar to norcaradiene is suggested as the reactive intermediate.

3341

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE ABSORPTION SPECTRUM OF GASEOUS BENZYNE, by R. S. Berry, G. N. Spokes, and M. Stiles. [1962] [8]p. incl. diagrs. refs. (AFOSR-2399) (In cooperation with Michigan U., Ann Arbor) (AF AFOSR-61-25) AD 430657 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 3570-3577, Sept. 20, 1962.

Flash photolysis has been carried out on thin solid films of 2 substances known to give benzyne under other conditions. Transient and final product ultraviolet gas phase spectra have been recorded and at least 1-reaction has been observed, with butadiene. On the basis of the observed final products, the reactions and the appearance of a transient continuous spectrum, it is concluded that gaseous benzyne is produced and that it probably is responsible for the transient absorption spectrum. (Contractor's abstract)

3342

Yale U. Sterling Chemistry Lab., New Haven, Conn.

ABSORPTION SPECTRA OF GASEOUS HALIDE IONS AND HALOGEN ELECTRON AFFINITIES: CHLORINE, BROMINE, AND IODINE, by R. S. Berry, C. W. Reimann, and G. N. Spokes. [1962] [13]p. incl. illus. diagrs. tables, refs. (AFOSR-J1495) (AF AFOSR-61-25) AD 427550 Unclassified

Also published in Jour. Chem. Phys., v. 37: 2278-2290, Nov. 15, 1962.

Absorption spectra have been taken of partially dissociated vapors of chloride, bromide, and iodide salts of rubidium and cesium. The salts have been heated by shock waves. Continuous absorption spectra characterized by sharp thresholds are attributed to the ions Cl^-, Br^-, and I^-. The low-energy thresholds for the 3 ions fall at approximately 3424, 3685, and 4040A, respectively. From the threshold wavelengths and appropriate small environmental corrections, the electron affinities of chlorine, bromine, and iodine are determined to be 3.628±0.005, and 3.078±0.005 ev, respectively.

3343

Yale U. Sterling Chemistry Lab., New Haven, Conn.

ABSORPTION SPECTRUM OF GASEOUS F- AND ELECTRON AFFINITIES OF THE HALOGEN ATOMS, by R. S. Berry and C. W. Reimann. [1962] [4]p. incl. illus. diagr. table, refs. (AFOSR-65-1253) (AF AFOSR-63-183) AD 621462 Unclassified

Also published in Jour. Chem. Phys., v. 38: 1540-1543, Apr. 1 1963.

The absorption spectrum of gaseous fluoride ion has been observed in shock-heated vapors of CsF, RbF, and KF. The spectrum is a continuum with 2 sharp thresholds at 3595 and 3542A, similar to those of the other halide ions. The electron affinity determined from the low-energy threshold is 3.448 ± 0.005 ev. The cross-section for photodetachment at 3565A is about $2.5 \pm 2 \times 10^{-18}$ cm^2 and at 3525, about $3.3 \pm 2 \times 10^{-18}$ cm^2. The electron affinities of chlorine,

bromine and iodine are revised, respectively, to 3.613, 3.363, and 3.063 ev, all with uncertainties of 0.003 ev.

3344

Yeshiva U. Graduate School of Science, New York.

STATISTICAL THERMODYNAMICS OF NONUNIFORM FLUIDS, by J. L. Lebowitz and J. K. Percus. [1962] [8]p. incl. refs. (AFOSR-4112) (In cooperation with New York U.) (AF 49(638)753) AD 292937 Unclassified

Presented at meeting of the Amer. Phys. Soc., Northwestern U., Evanston, Ill., June 19-21, 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 415, June 19, 1962. (Title varies)

Also published in Jour. Math. Phys., v. 4: 116-123, Jan. 1963.

A general formalism has been developed for obtaining the low-order distribution functions $n_q(r_1, \cdots, r_q)$ and the thermodynamic parameters of nonuniform equilibrium systems where the nonuniformity is caused by a potential U(r). The method consists of transforming from an initial (uniform) density n_0 to the final desired density n(r) via a functional Taylor expansion. When n_0 is chosen to be the density in the neighborhood of the r's one obtains n_q as an expansion in the gradients of the density. The expansion parameter is essentially the ratio of the microscopic correlation length to the scale of the inhomogeneities. Analysis is most conveniently done in the grand ensemble formalism where the corresponding thermodynamic potential serves as the generating functional [with U(r) as the variable] for the n_q. The transition from U(r) to n(r) as the relevant variable is accomplished via the direct correlation function which enters very naturally, relating the change in U at r_2 due to a change in n at r_1. It is thus essentially the matrix inverse of the 2-particle Ursell function. The recent results of Stillinger and Buff on the thermodynamic potentials for nonuniform systems follow as a special case of analysis without any recourse to the virial expansion. Thus, they hold also in the liquid region. In a succeeding paper, analysis is applied to obtain the asymptotic behavior of the radial distribution function in a uniform system.

3345

Yeshiva U. [Graduate School of Science] New York.

DISSOCIATION ROLE OF A DIATOMIC MOLECULE IN AN INERT GAS (Abstract), by T. A. Bak and J. L. Lebowitz. [1962] [1]p. (In cooperation with New York U.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)753] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 42, Jan. 24, 1962.

The dissociation rate of a dilute solution of diatomic molecules in an inert gas which is suddenly raised to a high temperature was investigated. A classical impulsive collision model is used for the interaction between the diatomic molecules and the solvent gas which is treated as a temperature bath at a temperature T. Explicit calculations have been carried out for a 1 dimensional harmonic model (including also transitional degrees of freedom assumed to be in equilibrium with the reservoir), in which the diatomic molecule is assumed to dissociate as soon as its vibrational energy exceeds the dissociation energy E. An apparently general result was obtained (independent of the form of the vibrational potential) for the dissociation rate

$$K(E) \text{ in the region } E \gg kT;\ K(E) \approx kT\,[\tau(E)]^{-1} f(E),$$

where f(E) dE is the probability of the molecule having vibrational energy in the range dE when it is in equilibrium at temperature T, and $\tau(E)$ is the time between collisions for molecules with vibrational energy E. This may be related to the maximum amplitude of vibration and is much larger and in better agreement with experiment than the K obtained from a weak interaction model.

3346

Yeshiva U. [Graduate School of Science] New York.

DYNAMICAL STUDY OF BROWNIAN MOTION (Abstract), by J. L. Lebowitz and E. L. Rubin. [1962] [1]p. [AF 49(638)753] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 24-27, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 82, Jan. 24, 1962.

A study was made on the motion of Brownian particles in a fluid, (through the time evolution of their distribution function), from a dynamical point of view; i.e., without a priori introduction of purely stochastic elements. The method consists of rewriting the Liouville equation for the joint distribution μ, of fluid and Brownian particle (which may itself be composite) as a pair of coupled non-linear equations for the distribution function of the Brownian particle f, and the conditional distribution of the fluid (μ/f). These equations are then solved by an iteration procedure which is essentially an expansion in the ratio of the "effective" velocities of Brownian and fluid particles. A Fokker-Planck type equation for the Brownian particles was obtained. The next order yields a simple correction for spatially nonuniform distributions of Brownian particles. The evaluation of the higher order terms lead to some serious difficulties which will be discussed. The relationship between this procedure and the Kirkwood theory of liquids is also being investigated.

3347

Yeshiva U. [Graduate School of Science] New York.

RADIAL DISTRIBUTION FUNCTIONS IN CRYSTALS AND FLUIDS (Abstract), by J. L. Lebowitz, J. K. Percus, and I. J. Zucker. [1962] [1]p. (In cooperation with New York U.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)753] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Northwestern U., Evanston, Ill., June 19-21, 1962.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 415, June 19, 1962.

A study is being made of the qualitative nature of the 2-particle distribution function $n_2(r_1, r_2)$ with particular reference to its long-range behavior in crystals and fluids. In a box with periodic boundary conditions, $n_2(r_1, r_2) = n_2(r_1, r_2)$ and in the limit of the system becoming infinite is equal to $n^2 g(r)$. The low-k behavior of $\sigma(k)$, the Laplace transform of g(r) is studied. This yields the moments of (g-1) and may thus give information about the existence of long-range order. $\sigma(k)$ is related to $\langle \rho k \rho - k \rangle$, where ρk is the Fourier transform of the density. In the crystalline state, pk may be expressed in terms of the normal coordinates and $\sigma(k)$ evaluated for some harmonic crystals. For a 1-dimensional system with nearest neighbor forces, $\sigma(k)$ is given directly in terms of the thermodynamic parameters of the system; $\sigma(k) = [n \exp(\mu(p + k) - \mu(p)) - n]^{-1}$, where μ, the chemical potential and p, the pressure, are measured in units of temperature. The absence of phase transitions here implies the existence of all the moments of (g-1) and the absence of long range order.

3348

Yeshiva U. [Graduate School of Science] New York.

ASYMPTOTIC BEHAVIOR OF THE RADIAL DISTRIBUTION FUNCTION, by J. L. Lebowitz and J. K. Percus. [1962] [7]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-64] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York U. N. Y., Jan. 23-26, 1963.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 8: 32, Jan. 23, 1963.

Also published in Jour. Math. Phys., v. 4: 248-254, Feb. 1963.

The pair distribution function in a uniform classical fluid is equivalent to the 1-body density when 1 particle is fixed. An implicit relation for this nonuniform density is found by a functional expansion of the difference of chemical potential and external potential about its value for a system of uniform density. A linearization of this expansion, followed by retention of, at most, second derivatives of the inhomogenity, reproduces the Ornstein-Zernicke relations for the asymptotic pair correlation. Linearization alone calls for the sum of internal potential and direct correlation function to vanish asymptotically. This relation is developed for the case of weak long-range forces, resulting in the Debye-Huckel expression for an electron gas, and reproducing the asymptotic correlations of the Kac-Uhlenbeck-Hemmer 1-dimensional model. The relation is also shown to follow from the virial expansion for the direct correlation function.

3349

Yeshiva U. [Graduate School of Science] New York.

DISSOCIATION OF DIATOMIC MOLECULES, by T. A. Bak and J. L. Lebowitz. [1962] [9]p. incl. refs. [AF AFOSR-62-64] Unclassified

Published in Faraday Soc. Discussions, v. 33: 189-197, 1962.

A diatomic molecule is considered as 2 hard spheres connected by a spring. It is imbedded in a gas of hard-sphere atoms, which is assumed to be in thermal equilibrium at all times. Only a 1-dimensional model is considered, and the possibility of multiple collisions during an encounter is neglected. The molecule is assumed to dissociate immediately whenever its vibrational energy exceeds E. The density in the phase space of the diatomic molecule is described by the Liouville equation for the isolated molecule with an added collision integral for collisions with the gas atoms. Since the gas is assumed in equilibrium this integral equation is linear. The rate constant for dissociations is found directly from the integral equation and (for small mass of the gas atoms) after its reduction to a Fokker-Planck equation.

3350

Yeshiva U. [Graduate School of Science] New York.

CREATIVITY AND EFFECTIVE INSEPARABILITY, by R. M. Smullyan. [1962] [11]p. (AFOSR-64-0231) (AF AFOSR-63-433) AD 432519 Unclassified

Also published in Trans. Amer. Math. Soc., v. 109: 135-145, Oct. 1963.

Some new characterizations of creativity and effective inseparability (as well as some closely allied notions) which seem surprisingly weak are obtained. These results are in some respects stronger than those previously obtained in other studies of the theory of formal systems.

3351

Zaragoza U. (Spain)

QUANTUM MECHANICAL APPLICATIONS TO CLASSICAL PERTURBATION THEORY, by L. M. Garrido. Final rept. July 30, 1962, 7p. (AFOSR-3545) (AF EOAR 61-33) AD 285291 Unclassified

In this study of classical mechanics using the methods of quantum mechanics, a Hilbert space is introduced, and an action principle for classical fields and Schwinger's action principle for classical mechanics deduced. A general perturbation theory, is presented and methods are applied to the study of plasma's adiabatic invariants, plasma's confinement between magnetic mirrors, and classical transport coefficients.

3352

Zator Co., Cambridge, Mass.

WANTED: A REACTIVE TYPEWRITER, by C. N. Mooers. Final rept. Oct. 1962, 25p. incl. refs. (Rept. no. ZTB-142) (AFOSR-2711) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)376, Gmelin Institute, National Institutes of Health and Rome Air Development Center) AD 400349 Unclassified

Some critical remarks are directed at many current and fashionable topics in information retrieval. The information crisis is attributed to the challenge of new machines, not to an unexpected surge in literature. The concentration on retrieval selector machines is discounted as misplaced emphasis. Programs in which information retrieval is an activity for independent effort at each documentation center are described as dated and leading to unnecessary duplication of costly effort. Thesaurus building is analyzed as a neo-uniterm aberration undertaken in the mistaken belief that thesaurus word lists can discover meanings in texts. Compound descriptors and their algebra are mentioned. The very important future use of remote computers by means of typewriters in the library with wire connection to the computer is described. Such wire-connected typewriters are called "reactive typewriters." The impediments to getting reactive typewriters are enumerated. Appropriate wire-connecting typewriters having both upper and lower case characters are only available at exorbitant cost at present, i.e., about $10,000 for each typewriter terminal. Arguments are given to show that the cost should be in the order of $500 to $1000 for the sa small library users. Omissions of necessary hardware in contemporary computing machines are listed. Programming languages for the reactive typewriter are discussed, and the features of the TRAC language are mentioned. Some of the broader capabilities and consequences of the reactive typewriter are sketched. A plea is made for cooperation by potential users to insist that the manufacturers make available reactive typewriter equipment at reasonable prices. (Contractor's abstract)

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	3686	2754
	3687	2755
	3688	2756
	3689	2757
	3692	1623
	3693	3076
	3694	3077
	3695	974
	3696	975
	3697	976
	3698	977
	3699	732
	3701	1953
	3703	2197
	3704	71
	3705	1315
	3706	1316
	3707	1317
	3709	1318
	3710	786
	3711	2409
	3714	2073
	3715	3021
	3716	1950
	3717	1450
	3718	31
	3732	1030
	3736	926
	3737	1958
	3740	1667
	3741	124
	3742	2413
	3744	390
	3746	3216
	3748	1962
	3758	1399
	3759	1400
	3762	1926
	3763	1323
	3764	917
	3766	2680
	3767	1328
	3769	2074
	3770	2358
	3778	2681
	3779	1922
	3781	2677
	3782	3016
	3783	1927
	3785	142
	3786	2053
	3789	2557

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AFOSR-	3790	1612	AFOSR-	3943	2698
	3791	765		3944	927
	3794	86		3945	928
	3804	2570		3946	2040
	3806	2571		3955	2830
	3808	711		3956	2831
	3817	480		3957	680
	3824	745		3961	1616
	3826	2983		3965	1650
	3830	2326		3966	1102
	3831	1600		3969	1103
	3832	2784		3973	2585
	3833	842		3974	1775
	3835	1352		3976	2493
	3836	1353		3977	2494
	3837	843		3978	2495
	3860	1279		3979	2425
	3861	1100		3980	2426
	3865	3207		3984	385
	3867	667		3985	2030
	3871	2974		3986	1534
	3872	3286		3989	972
	3873	1624		3990	972
	3874	3180		3994	506
	3875	1579		3998	1258
	3877	742		3999	115
	3880	959		4000	3288
	3881	2788		4001	241
	3882	2003		4002	1228
	3885	2300		4003	2331
	3886	3287		4004	2332
	3887	95		4007	736
	3888	704		4012	1177
	3889	2483		4016	2162
	3890	3339		4017	2183
	3893	2429		4029	595
	3897	981		4030	596
	3898, V. 1	965		4039	597
	3898, V. 2	966		4040	598
	3899	2159		4041	2109
	3900	2424		4042	1964
	3901	96		4043	2206
	3903	1625		4044	87
	3905	2743		4045	3176
	3906	1959		4047	300
	3907	2922		4048	301
	3908	2923		4050	321
	3909	3242		4051	681
	3910	2289		4052	3139
	3911	754		4053	3137
	3912	44		4054	3138
	3926	944		4055	3096
	3928	2729		4057	1156
	3931	818		4058	3025
	3932	819		4059	125
	3933	820		4060	2265
	3934	821		4061	1150
	3938	1904		4062	1475
	3939	1561		4063	1476
	3940	2810		4064	1477

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AFOSR-	4066	4	AFOSR-	4181	1032
	4068	5		4183	47
	4069	462		4185	1539
	4071	1948		4188	950
	4073	469		4189	1009
	4074	1562		4190	1436
	4075	2645		4191	1773
	4076	1539		4192	3232
	4077	1637		4193	3105
	4078	1672		4194	2697
	4079	2464		4195	1334
	4080	2916		4196	1335
	4081	2219		4197	1336
	4082	2707		4198	1337
	4083	2815		4199	1338
	4085	1111		4201	1916
	4108	1651		4202	1037
	4110	963		4204	1339
	4111	945		4205	921
	4112	3344		4206	2191
	4125	2633		4212	2789
	4127	2639		4213	1601
	4128	2640		4214	1602
	4130	2301		4217	693
	4131	2302		4218	448
	4132	2303		4219	449
	4134	2304		4223	1192
	4135	2305		4224	718
	4136	2306		4225	1628
	4137	2307		4226	1754
	4138	2308		4228	3294
	4139	2309		4229	3295
	4140	2310		4231	3296
	4141	2311		4232	3297
	4142	2312		4233	1674
	4143	2313		4234	1983
	4144	2314		4235	2359
	4145	2315		4236	2010
	4146	2316		4238	3089
	4148	257		4239	1647
	4152	2563		4242	2368
	4153	884		4243	2369
	4154	2917		4244	951
	4157	150		4245	787
	4161	2924		4247	794
	4162	2443		4248	795
	4163	2099		4249	6
	4164	1157		4251	1231
	4165	1627		4274	3041
	4166	391		4275	2253
	4167	392		4278	593
	4168	151		4282	1028
	4169	152		4283	2696
	4170	1008		4292	2239
	4171	2386		4297	1165
	4172	1333		4298	562
	4173	540		4299	3178
	4178	2367		4302	1629
	4179	1504		4305	2287
	4190	493		4306	1140

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AFOSR-	4307	762	AFOSR-	4408	1613
	4308	273		4410	1987
	4311	3163		4411	3017
	4312	2135		4413	2956
	4313	2057		4414	3161
	4314	2058		4415	1451
	4315	2059		4416	3116
	4318	2392		4417	3117
	4318, Pt. 2	2393		4418	3118
	4319	2832		4419	3119
	4321	978		4420	3120
	4322	1046		4421	2641
	4324	1025		4422	901
	4325	2714		4423	563
	4327	1038		4436	3209
	4328	1039		4439	402
	4334	1040		4446	1148
	4336	3277		4461	2664
	4337	2240		4472	2143
	4338	541		4473	1233
	4339	3023		4475	507
	4341	2355		4480	1371
	4343	3150		4483	2594
	4344	1417		4502	2496
	4345	1418		4503	2452
	4346	1437		4504	2453
	4347	1438		4505	2467
	4348	1439		4506	2468
	4349	1440		4508	2469
	4352	2041		4509	2470
	4353	615		4510	2465
	4358	2121		4514	1552
	4359	2672		4516	342
	4361	3015		4522	1642
	4362	2281		4529	2523
	4333	2282		4530	2524
	4364	2066		4531	2879
	4365	1310		4532	2477
	4366	2274		4536	1614
	4367	1137		4540	2496
	4368	3088		4541	2497
	4369	2673		4542	2498
	4371	3205		4548	316
	4372	[illegible]0		4551	2404
	4373			4555	2580
	4374			4556	343
	4376	[illegible]		4557	341
	4380	2765		4558	[illegible]
	4381	1266		4564	2572
	4382	425		4571	844
	4383	264		4572	1414
	4384	3048		4573	51
	4385	3049		4574	619
	4400	1478		4579	2075
	4402	2338		4581	1329
	4403	235		4582	2674
	4404	2984		4583	1425
	4405	198		4584	3027
	4407	111		4585	1138

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	4590	917
	4591	3018
	4593	2969
	4597	2076
	4602	53
	4603	2454
	4604	212
	4608	2110
	4615	1031
	4620	521
	4624	2665
	4626	11
	4635	982
	4636	983
	4639	1645
	4641	2758
	4645	3289
	4646	3290
	4647	3293
	4650	3178
	4658	3291
	4665	2006
	4673	1101
	4675	2581
	4680	2575
	4682	528
	4683	529
	4685	530
	4687	1923
	4690	1153
	4691	2431
	4694	3083
	4698	522
	4699	523
	4701	2164
	4713	1
	4719	2471
	4720	2472
	4727	217
	4729	1312
	4737	2955
	4746	2011
	4747	643
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	4749	3328
	4751	133
	4755	803
	4769	1646
	4778	1563
	4780	1689
	4787	559
	4790	2967
	4796	357
	4803	263
	4815	1495
	4820	1389

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AFOSR-	4829	2884
	4832	2060
	4863	940
	4869	2054
	4870	2055
	4875	549
	4876	2512
	4899	292
	4904	48
	4905	1924
	4909	2038
	4912	3194
	4919	230
	4942	2766
	4949	1349
	4970	1776
	4980	2573
	4981	393
	4984	1679
	4985	394
	4987	1638
	5003	755
	5005	3247
	5006	3248
	5007	3249
	5008	3250
	5009	3251
	5013	2891
	5014	1777
	5031	1778
	5033	1779
	5036	2925
	5040	191
	5045	2564
	5050	476
	5062	2569
	5063	147
	5081	1301
	5084	2081
	5108	1481
	5113	849
	5115	2525
	5121	788
	5133	2084
	5171	591
	5174	2740
	5194	2595
	5202	3146
	5215	2708
	5250	599
	5271	223
	5287	2275
	5299	1369
	5312	2268
	5316	3135
	5345	432
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	14	61
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	19	2036
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AFOSR-J	1	1351
	4	204
	6	1467
	7	2545
	9	2546
	10	1468
	11	1603
	13	2555
	14	1259
	15	508
	16	1020
	18	322; 2540
	27	1104
	31	3019
	35	463
	37	3193
	39	2611
	42	686
	43	481
	45	1517
	46	2170
	48	3182
	50	1527
	52	464
	54	1372
	56	192
	59	495
	61	2904
	67	2209
	80	1021
	84	2280
	85	689
	86	642
	87	650
	96	237
	102	1385
	104	3223
	105	412
	106	1512
	107	3245
AFOSR-J	117	3246
	118	2256
	120	2746
	121	251
	123	1780
	124	1781
	125	1782
	126	2210
	127	290
	129	1290
	130	2989
	131	2532
	134	826
	135	1965
	137	323
	141	3122
	142	3326
	143	1452
	144	1966
	145	3189
	148	450
	152	1154
	153	1755
	157	1756
	158	2646
	159	2144
	161	1945
	162	2990
	163	2547
	164	705
	166	680
	168	271
	169	910
	174	2255
	175	837
	176	2256
	178	3230
	179	922
	181	3086
	183	679
	185	2520
	186	2138
	187	1661
	188	979
	190	1662
	195	2370
	196	1010
	197	1011
	198	750
	199	751
	200	1441
	201	1442
	203	1340
	204	1341
	205	938
	207	708
	208	1463
	209	1035
	211	1415
	212	3064

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	221	483		303	2247
	222	3252		304	2248
	223	3253		310	2249
	224	1113		312	602
	226	108		316	3123
	227	2148		317	537
	229	2833		318	1453
	231	2834		319	1921
	232	2835		320	2629
	233	1342		321	668
	234	1343		322	669
	235	1344		323	670
	236	1345		324	2515
	237	2350		326	2516
	238	205		327	2970
	239	1121		330	2149
	240	1122		331	2849
	241	190		338	304
	242	3243		341	3190
	244	809		342	403
	245	2351		343	1506
	248	2094		344	1507
	249	2095		346	968
	250	2096		356	3123
	251	426		358	1047
	252	3334		362	1160
	253	258		366	2730
	254	259		368	2453
	256	1324		369	3063
	257	2576		370	746
	259	171		372	815
	260	2596		373	2172
	262	1012		374	2552
	263	1013		375	578
	264	404		376	579
	265	1149		364	2251
	266	108		377	580
	267	624		378	581
	269	470		379	582
	270	2648		381	1015
	271	2299		382	3192
	272	1520		387	2782
	273	1521		388	324
	274	1757		389	1493
	278	1114		391	1643
	280	3165		392	337
	281	3244		393	2836
	285	3036		394	2837
	286	3035		395	328
	287	1260		396	329
	289	206		400	427
	290	207		407	911
	294	2905		413	912
	295	2906		417	913
	296	3329		419	914
	297	88		421	915
	298	109		425	807
	300	2507		426	1604
	301	2508		427	3311

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AFOSR-J	432	633
	434	634
	437	2430
	438	1615
	439	2042
	440	2377
	441	2150
	443	2020
	444	294
	445	295
	446	2623
	448	2625
	449	551
	450	2151
	452	443
	458	941
	461	572
	466	933
	468	2241
	471	1036
	472	45
	473	123
	474	2152
	475	173
	479	2574
	480	2850
	481	2759
	484	1514
	488	2871
	489	2872
	494	1041
	500	2851
	501	2852
	502	2853
	503	2913
	504	2112
	505	1967
	506	594
	507	1280
	508	2657
	510	1997
	513	2678
	517	2517
	523	2948
	524	2873
	530	406
	531	2360
	534	1124
	536	2116
	537	2117
	538	2118
	539	1956
	540	1758
	541	1759
	542	2228
	543	2874
	546	478
	549	1115
	551	1454
	552	1455

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AFOSR-A	555	1116
	556	533
	557	3167
	559	2018
	562	512
	563	471
	565	84
	566	934
	567	85
	568	935
	569	936
	571	2612
	572	2613
	574	589
	579	419
	580	1243
	581	2717
	584	763
	587	1605
	589	2658
	590	413
	591	2649
	592	414
	593	625
	594	1760
	596	1761
	598	3292
	599	2333
	604	2650
	605	2432
	606	2553
	607	1416
	608	2712
	615	546
	617	326
	618	1606
	620	3316
	621	3317
	623	2621
	624	2153
	625	2991
	626	531
	627	2858
	631	2341
	634	2839
	637	2085
	638	2086
	639	1531
	645	3299
	646	2356
	647	2875
	648	1489
	651	2051
	655	3206
	658	1947
	659	1518
	661	613
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AFOSR-J	667	2630	AFOSR-J	812	2535
	668	2631		814	2536
	670	193		818	2537
	682	2181		822	1644
	688	1520		823	1639
	691	1117		828	2695
	693	2547		830	1404
	696	2651		831	2549
	699	816		832	194
	702	952		833	1917
	703	1014		834	1918
	704	2847		835	3273
	705	1118		836	3274
	707	472		839	496
	712	2063		840	3160
	714	2605		842	600
	716	747		843	46
	717	2339		845	2550
	722	716		860	766
	723	617		861	709
	725	2768		864	452
	727	1652		865	554
	728	811		867	1263
	734	789		868	1264
	735	790		869	1265
	736	791		871	1253
	739	2160		872	2909
	741	482		873	1578
	743	1229		875	317
				877	2167
	744	2992			
	745	1519		879	2559
	750	3170		880	2262
	751	2682		881	2263
	755	1402		882	1390
	756	1403		883	1391
	758	3254		885	2690
	759	2189		890	605
	760	1234		892	590
	763	980		894	2606
				896	2511
	764	1365			
	765	2965		900	2361
	766	1366		904	197
	775	451		907	226
	778	3124		913	3166
	781	1483		916	110
	782	1303		923	2513
	784	827		927	2679
	785	828		931	2713
	786	2526		934	1305
				936	1464
	788	2527			
	789	2528		937	1465
	790	2529		939	1466
	792	2530		941	838
	795	2531		947	3231
	796	2532		951	3233
	797	829		953	497
	801	230		955	2242
	805	2533		956	2243
	811	2534		957	2614
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	966	1456		1099	78
	972	1392		1103	758
	974	107		1105	2542
	978	1783		1119	1802
	979	1784		1131	2326
	980	1894		1139	2488
	981	1785		1149	361
	982	1786		1153	604
	983	1787		1154	1319
	984	1788		1165	2198
	985	1789		1173	189
	986	1790		1190	1940
	987	1791		1191	1941
	989	1792		1192	1942
	991	1793		1194	1943
	992	1794		1198	1972
	995	1795		1201	3032
	996	1796		1202	3034
	997	1797		1203	3037
	998	1798		1204	3038
	999	1799		1210	178
	1005	1800		1212	2119
	1006	1801		1217	2597
	1008	362		1218	2598
	1012	2505		1220	1373
	1014	1490		1236	1540
	1023	3278		1238	990
	1027	2973		1251	2559
	1028	2799		1252	2560
	1030	129		1260	626
	1031	130		1265	2783
	1032	131		1267	2226
	1033	2031		1274	2120
	1034	801		1277	555
	1036	2131		1288	358
	1038	32		1296	830
	1040	2800		1299	331
	1041	1677		1300	832
	1042	986		1301	833
	1043	2405		1305	146
	1044	964		1307	2661
	1045	792		1312	2818
	1046	1626		1326	2371
	1047	733		1372	3094
	1048	1000		1378	851
	1049	2500		1380	856
	1050	188		1382	1895
	1051	542		1383	1896
	1060	428		1385	1803
	1065	429		1397	363
	1073	3168		1398	857
	1081	376		1405	858
	1083	7		1407	659
	1086	377		1408	660
	1087	378		1420	1419
	1088	379		1438	627
	1092	8		1439	628
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